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ABSTRACT

This volume consists of elementary job and task sheets adaptable for use in the regular vocational industrial education programs for the training of machinists and machine shop operators. Twenty-five simple machine shop job sheets are included. Some or all of this material is provided for each job sheet: an introductory sheet with aim, checking standards, and references; drawing(s); a job sheet that details the job, materials, tools and equipment, general instructions, procedures and/or tasks, and checkpoints; and task sheets. These task sheets are broken down into steps and key points for ease of carrying the learner through the job step-by-step and are keyed to working stations and machines of a machine shop. These 25 jobs are covered: clamp strap, drill drift, U-clamp strap, T-nut, step block, stud, parallel blocks, parallel bars, bench plate, limit gauge, steel washers, lapping plate, angle plates, test bar, lathe mandrel, arbor collar, jig bushings, prick and center punches, hand and machine punches, round nail sets, square nail sets, T-head bolts, planer bolts, fillister head cap screw, square head set screw, and hex head cap screw. (YLB)

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ED241800

MACHINE SHOP

Suggested Job And Task Sheets

Part I

25 Elementary Jobs

CE 038 891

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A

SUGGESTED SET OF JOB AND TASK SHEETS

FOR

MACHINE SHOP TRAINING

PRINTED 1975

ISSUED BY

VOCATIONAL INSTRUCTIONAL SERVICES
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VOCATIONAL INDUSTRIAL EDUCATION

FOREWORD

The elementary job and task sheets included in this series are adaptable for use in the regular vocational industrial education programs for the training of machinists and machine shop machine operators.

In the planning of this series of elementary job and task sheets a concerted effort has been made to include only those articles that can be used in the machine shop. This will have the results of not only conserving materials but will increase the interest of learners in their work.

Suggestions are included for teachers which may be of help in making the best use of the job and task sheet series.

Part I consists of a twenty-five simple machine shop job sheet series. Each job is accompanied by task sheets. The task sheets are broken down into steps and key points for ease of carrying the learner through the job step by step. The task sheets are keyed to work stations and machines of a machine shop.

ACKNOWLEDGEMENT

Sincere thanks and appreciation is extended to Gerald L. Callaway, Instructor of Metal Trades, Brownwood Senior High School, Brownwood, Texas, for the development of the Machine Shop job and task sheets.

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I. USE OF THE JOB SHEET SERIES

In compiling the jobs for this series, all essential details of production procedures necessary to train an operator for a special unit skill occupation have been considered and included as far as possible. It will, however, be necessary for the instructor to analyze each job as assignments are made to learners and check to be sure that all information necessary for instruction is included on the job and task sheets.

If the details on the job and task sheets do not wholly meet the needs of the learner, it will be necessary for the instructor to expand or modify the information to conform to the situation at hand. After desirable modifications have been made, it is expected that the instructor will arrange for the reproduction of a sufficient number of sheets to accommodate the learners.

In helping the learners with new experiences, instruction supplementary to the information given on the job and task sheets should always be in order. This may take the form of a shop demonstration, a shop talk, working with the individual learner, or referring the learner to suitable reference materials. Safe methods of working in connection with the assigned jobs must always be emphasized.

The job and task sheets are set up in such a fashion as to lead the learner in the learning process from the simple to the complex. As the learner progresses through the twenty-five jobs more and more machines are used, the machines become more complex to set up and operate, and the jobs become more complex. Many opportunities have been built into the jobs to afford the learner the occasion to become experienced in making judgments and decisions concerning procedures, processes, and calculations.

It will be noted that all of the projects require more than one task for completion. As this occurs a task sheet is included for each task. In all cases the training requires that the job be routed from one training station to another. The intent here is to approximate the production plan in industry and assure effective training for a given learner in a unit skill occupation.

Use of Tolerances

The tolerances specified on the drawings in this series are made to conform to standard industrial practice as nearly as possible. These tolerances should be adhered to as nearly as shop conditions will allow; otherwise, the training will not completely serve its purpose. Repetition of a task by the learner until tolerances are attained is essential to qualification for employment in the skilled occupation. This repetition is made possible by organizing the work on a production basis whereby the twenty-five jobs route the learners through the various training stations of a machine shop many times.

Variation in Machine Equipment

The proper sequence of machines or type of task necessary for the completion of each job has been noted on the job sheets. This sequence may be changed whenever necessary to meet shop conditions. In many cases the task may be done with either of two types of machines such as a milling machine or a shaper. In this case the two tasks are detailed on separate task sheets. This is done because of the known limitations of equipment in some shops and also to emphasize the fact that there are often more ways than one to perform a task.

Limitations in Using Job and Task Sheets

The instructor should bear in mind at all times that instruction sheets do not include technical information involved in processing. The demonstration, shop talks, working with learners on the job, or referring learners to specific printed material are always essential supplementary teaching methods that must be used. Additional necessary related information and instruction, such as reading blueprints and making calculations, should be taught as the learners progress through the jobs. Shop reference books and pamphlets should always be at hand in the shop library, and this printed material should be used as needed and required by the learners to obtain information on all aspects of the occupation.

The job and task sheets of this series are set up as suggestions only. It is the instructor's privilege to modify job and task sheets to meet the conditions existing in the shop. At times it will be essential to change information or procedures outlined on the job and task sheets. In this case additional job and task sheets should be provided to meet specific training needs and to include additional jobs.

This job sheet series does not include all the tasks that can be performed on the machines listed. In case training requirements call for other tasks than those found in the Chart of Tasks, the instructor will find it necessary to find other jobs or tasks which include the required tasks.

II. USE OF THE DRAWINGS

The drawings provided in connection with each job are working drawings made to conform as closely as possible to industrial standards. The drawings are printed on tracing paper so as to make possible their reproduction in blueprint form by the local schools. It is expected that the learner will become familiar with the reading of blueprints so that the finished product of a job may be visualized and an understanding created of the tasks involved in the job. Instruction in blueprint reading, interpreting specifications, and making necessary calculations must be given with each job.

III. USE OF REFERENCES

The use of references, in any form that will be helpful to the learner, will be an aid to the instructor in successful teaching. The instructor should have available for the learner at all times reference material which will assist the learner in obtaining additional information related to the job on which work is being done.

IV. ANALYSIS OF TASKS

The following chart, Chart for Prints and Job Sheets, lists items to be made, print numbers, and types of tasks involved in the processing. This chart should prove helpful to the instructor in making learner assignments. The chart can be used in connection with a progress chart to check the coverage of the learners' progress through the course. The jobs covering types of tasks such as bench work, drill press work, etc. are in the learning order, simple to the complex, insofar as possible. The order in which the different types of tasks occur on the chart for a given article does not necessarily represent the order in which the tasks are performed in production.

CHART FOR PRINTS AND JOB SHEETS

PRINT AND JOB NO.	JOBS	TASK NUMBERS										
		HEAT TREAT	BENCH	ENGINE LATHE	TURRET LATHE	DRILL PRESS	SHAPER	MILLING MACHINE	CYLINDRICAL GRINDER	INTERNAL GRINDER	SURFACE GRINDER	POWER HACKSAW
1.	CLAMP STRAP		1			1						1
2.	DRILL DRIFT		2			2	1					2
3.	U-CLAMP STRAP		3			3						3
4.	T-NUT		4			4	2	1				4
5.	STEP BLOCK		5				3	2				
6.	STUD		6	1								
7.	PARALLEL BLOCKS	1	7				4	3			1	5
8.	PARALLEL BARS	2	8			5	5	4			2	
9.	BENCH PLATE						6				3	
10.	LIMIT GAUGE	3	9			6		5			4	
11.	STEEL WASHERS				1							
12.	LAPPING PLATE						7	6			5	
13.	ANGLE PLATES						8	7			6	
14.	TEST BAR	4		2					1			
15.	LATHE MANDREL	5		3			9	8	2			6
16.	ARBOR COLLAR	6		4	2		10		3	1	7	7
17.	JIG BUSHINGS	7	10	5	3	7			4	2		
18.	PUNCHES-PRICK AND CENTER			6								
19.	HAND AND MACHINE PUNCHES			7								
20a.	NAIL SETS-ROUND			8a								
20b.	NAIL SETS-SQUARE			8b								
21.	T-HEAD BOLTS			9				9				
22.	PLANER BOLTS			10				10				
23.	FILLISTER HEAD CAP SCREW				4			11				
24.	SQUARE HEAD SET SCREW	8			5							
25.	HEX HEAD CAP SCREW				6							

MACHINE SHOP CLAMP STRAP

POWER HACKSAW	1
DRILL PRESS	1
BENCH WORK	1

AIM: THE STUDENT WILL BE ABLE TO READ DRAWINGS, SELECT MATERIALS, AND CONSTRUCT A CLAMP STRAP ACCORDING TO SPECIFICATIONS; USING THE VARIOUS MACHINES, TOOLS, AND EQUIPMENT CALLED FOR IN THE JOB.

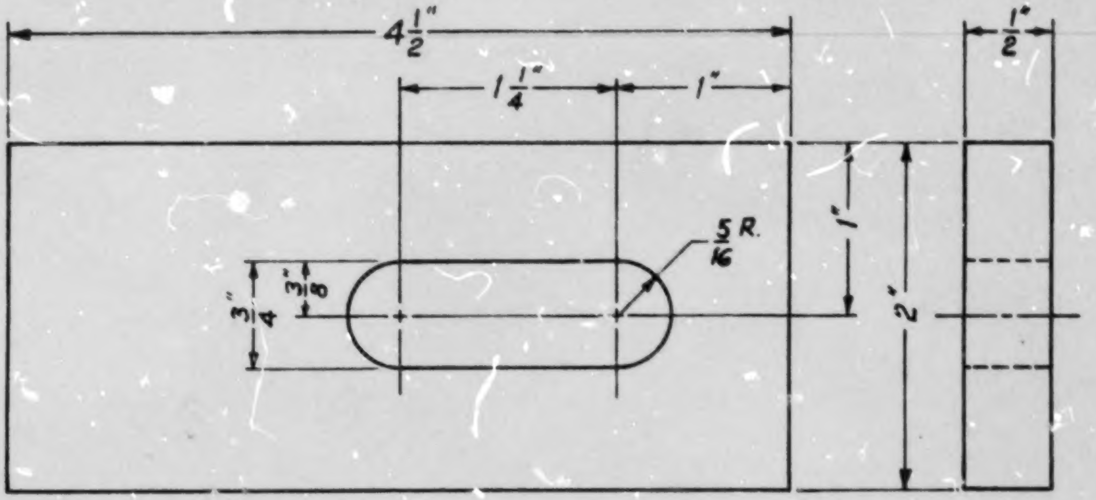
CHECKING STANDARDS

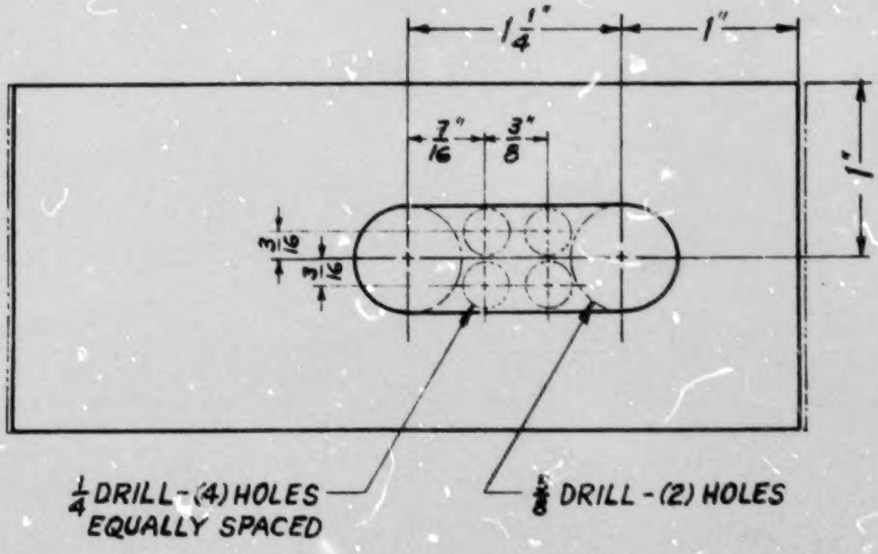
1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, AND EQUIPMENT.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING, GOODHEART-WILLCOX, 123 W. TAFT DRIVE, SOUTH HOLLAND, IL 60474, 1970, 520 PAGES, $5.97.

REF. #2, LUDWIG, OSWALD A., AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE, MCKNIGHT AND MCKNIGHT PUBLISHING COMPANY, BLOOMINGTON, IL 61701, 1969, 630 PAGES, $6.48.


4 1/2"
1 1/4"
1"
1/2"
5/16 R.
3/8"
3/4"
1"
2"


1 1/4"
1"
7/16"
3/8"
3/16
3/16
1"
1/4 DRILL-(4) HOLES
EQUALLY SPACED
5/8 DRILL-(2) HOLES

LAYOUT DRAWING

DRAWING NO. 1	CLAMP STRAP	TOLERANCE CHART
POWER HACKSAW NO. 1 DRILL PRESS NO. 1 BENCH JOB NO. 1	MATERIAL: C.R.S. FINISH: FILE & POLISH SCALE: FULL SIZE	FRACTIONS ±1/64 DECIMALS ±.005 ANGLES ±1/2°

PH-1

JOB SHEET
IN
POWER HACKSAW

JOB:	MAKE CLAMP STRAP
MATERIALS:	CUTTING OIL, COLD ROLLED FLAT STOCK STEEL, ONE PIECE 1/2" X 2" X 4 9/16"
TOOLS AND EQUIPMENT:	POWER HACKSAW, MILL FILE, 6" RULE, SCRIBE
GENERAL INSTRUCTIONS:	BEFORE BEGINNING JOB READ REF. #1, "POWER SAWING", PP. 35-1 TO 35-6. READ JOB AND TASK SHEET AND STUDY PRINT. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINES.
PROCEDURES AND/OR TASKS:	PH-1-1 SET UP POWER HACKSAW FOR TASK AND CHECK FOR PROPER RUNNING CONDITION PH-1-2 CUT CR FLAT STOCK TO LENGTH
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CORRECT MACHINE OPERATION AND SETUP.
2. SELECTION AND LAYOUT OF MATERIAL.
3. MATERIAL CUT AND FINISHED ACCORDING TO SPECIFICATIONS AND PRINT.

NAME: ____________________

PROGRESS CHART

MACHINE SHOP—PART I, PAGE 1

TASKS JOBS	BENCH																				DRILL PRESS								SHAPER							MILLING MACHINE													
	PREPARE SURFACE	LAYOUT	DRILL	COUNTERSINK	REAM	TAP	THREAD	POWER SAW	HAND SAW	CHIP	SHEAR	FILE	DRAW FILE	HAND GRIND	HAND LAP	STAMP	ASSEMBLE	BEND & STRAIGHTEN	SCRAPE	POLISH	DRILL TO LAYOUT	DRILL WITH DRILL JIG	COUNTERBORE	COUNTERSINK	REAM	TAP	LAP	SPOT FACE	HORIZONTAL SHAPE	VERTICAL SHAPE	RIGHT ANGLE SHAPE	ANGLE SHAPE	CUT SERRATIONS	CUT INTERNAL KEYWAY	FORM SHAPE	SLAB MILL	FACE MILL	END MILL	STRADDLE MILL	FORM MILL	HELICAL MILL	ANGULAR MILL	SLOT	SLIT	HOB GEAR	BORE	INDEX	SPACE	CUT WOODRUFF KEY
1. CLAMP STRAP																																																	
2. DRILL DRIFT																																																	
3. U-CLAMP STRAP																																																	
4. T-NUT																																																	
5. STEP BLOCK																																																	
6. STUD																																																	
7. PARALLEL BLOCKS																																																	
8. PARALLEL BARS																																																	
9. BENCH PLATE																																																	
10. LIMIT GAUGE																																																	
11. STEEL WASHERS																																																	
12. LAPPING PLATE																																																	
13. ANGLE PLATE																																																	
14. TEST BAR																																																	
15. MANDRELS																																																	
16. ARBOR COLLAR																																																	
17. JIG BUSHINGS																																																	
18. PRICK & CENTER PUNCH																																																	
19. PUNCH																																																	
20. NAIL SET																																																	
21. T-HEAD BOLTS																																																	
22. PLANER BOLTS																																																	
23. FILL. HD. CAP SCREWS																																																	
24. SQ. HD. CAP SCREWS																																																	
25. HEX. HD. CAP SCREWS																																																	

NAME: ____________________

PROGRESS CHART

MACHINE SHOP — PART I, PAGE 2

TASKS JOBS	ENGINE LATHE																									TURRET LATHE														INT. GR.				SURF. GR.				CYL. GR.				
	MOUNT WORK IN CHUCK	FACE	CENTER	MOUNT BETWEEN CENTERS	TURN	TURN SHOULDER	CUT TAPER W/ TAPER ATTACH.	CUT TAPER W/ COMPOUND REST	DRILL	BORE	GROOVE AND NECK	CUT RADIUS	REAM	REAM TAPER	COUNTERSINK	COUNTERBORE	CHAMFER	FORM	KNURL	CUT NAT. STD. THREADS	FILE	POLISH	CUT OFF	GRIND	TAPER BORE	TURN WITH BOX TOOL	CHAMFER	FORM	FACE	CENTER	DRILL	REAM	BORE	THREAD	FILE	NECK	COUNTERSINK	KNURL	CUT OFF	GRIND STRAIGHT HOLE	GRIND TAPERED HOLE	GRIND FACES	DRESS WHEEL	GRIND PLAIN SURFACE	GRIND ANGULAR SURFACE	GRIND SLOT	DRESS WHEEL	STRAIGHT GRIND	TAPER GRIND	GRIND TO SHOULDER	LAP CENTERS	DRESS WHEEL
1. CLAMP STRAP																																																				
2. DRILL DRIFT																																																				
3. U-CLAMP STRAP																																																				
4. T-NUT																																																				
5. STEP BLOCK																																																				
6. STUD																																																				
7. PARALLEL BLOCKS																																																			
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18. PRICK & CENTER PUNCH																																																				
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20. NAIL SET																																																				
21. T-HEAD BOLTS																																																				
22. PLANER BOLTS																																																				
23. FILL. HD. CAP SCREWS																																																				
24. SQ. HD. CAP SCREWS																																																				
25. HEX. HD. CAPSCREWS																																																				

TASK SHEET

JOB: PH-1
TASK: 1
PAGE: 1

TASK: SET UP POWER HACKSAW FOR TASK AND CHECK FOR PROPER RUNNING CONDITION

JOB: MAKE CLAMP STRAP

TRADE: MACHINIST

TOOLS AND MATERIALS: POWER HACKSAW, CUTTING OIL

TASK BREAKDOWN:

STEPS	KEY POINTS
1. GUARDS	1. IN PROPER POSITION 2. INSTALLED TIGHT 3. TIGHTEN IF NECESSARY
2. OILER	1. CHECK FOR PROPER OPERATION 2. FILL WITH CUTTING OIL 3. METERS PROPER AMOUNT OF CUTTING OIL ON WORK AREA
3. SAW BLADE	
A. RECIPROCATING SAW	1. SELECT BLADE, SHARP a. ALL-HARD BLADE, FOR ACCURACY OF CUTTING b. 4 OR 6 TOOTH BLADE, FOR READILY MACHINED METALS OR MISCELLANEOUS CUTTING
B. HORIZONTAL BAND SAW	2. SELECT BLADE, SHARP a. RAKER SET FOR GENERAL USE b. STANDARD TOOTH FOR FERROUS METALS
4. INSTALL BLADE	
A. HACKSAW	1. MOUNTED TO CUT ON POWER STROKE 2. FLAT AGAINST MOUNTING PLATES 3. PROPER TENSION a. CONSULT MANUFACTURER'S SPECIFICATIONS IF AVAILABLE b. IF NO SPECIFICATIONS AVAILABLE USE FOLLOWING METHOD

A. HACKSAW (CON'T.)	(1) TIGHTEN BLADE (2) TAP BLADE LIGHTLY IN CENTER WITH SMALL BALL PEEN HAMMER (3) PROPER TENSION WILL CAUSE BLADE TO GIVE OFF LOW TONED MUSICAL RING (4) IF BLADE IS TOO TIGHT THE SOUND WILL BE HIGH IN PITCH (5) IF BLADE IS TOO LOOSE THE SOUND WILL BE A DULL THUD (6) ADJUST BLADE TENSION UNTIL SATISFACTORY SOUND IS ACQUIRED
B. HORIZONTAL BAND SAW	1. TEETH POINTED IN DIRECTION OF SAW TRAVEL 2. MAKE SURE BLADE IS FIRMLY AND SQUARELY SEATED ON PULLEYS 3. BLADE TENSION ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS OR TIGHT ENOUGH TO KEEP BLADE FROM TWISTING 4. BLADE GUIDES ADJUSTED FOR BLADE TO BE SQUARE AND TRUE WITH WORK TABLE
5. SET SAW SPEED	1. SET FOR COLD ROLLED STEEL 2. SET FOR 1 1/2" FLAT STOCK

SKETCH: REFER TO DRAWING #1: CLAMP STRAP

REFERENCE: REF. #1, "POWER SAWING", PP. 35-1 TO 35-6

TASK SHEET

JOB: PH-1
TASK: 2
PAGE: 1

TASK:	SAW COLD ROLLED FLATSTOCK TO LENGTH
JOB:	MAKE CLAMP STRAP
TRADE:	MACHINIST
TOOLS AND MATERIALS:	COLD ROLLED FLAT STOCK STEEL 1/2" X 2", COMBINATION SQUARE, SCRIBE, SMOOTH MILL FILE, CUTTING OIL, BENCH BRUSH, CLEAN RAGS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SELECT METAL	1. COLD ROLLED STEEL 2. FLAT STOCK 3. 1/2" X 2" 4. LONG ENOUGH FOR JOB
2. LAYOUT	1. CHECK END OF STOCK FOR SQUARE a. USE COMBINATION SQUARE b. HEAD OF SQUARE ALONG LENGTH OF STOCK c. BLADE ACROSS 2" END OF STOCK d. SIGHT BETWEEN BLADE EDGE AND END OF STOCK 2. IF END OF STOCK IS MUCH OUT OF SQUARE MAKE LENGTH MEASUREMENT FOR JOB FROM SHORT SIDE OF STOCK 3. END OF STOCK MUST BE SQUARED IF ANGLE IS TOO GREAT 4. MEASURE STOCK FOR JOB a. FINISHED PART TO BE 4 1/2" b. LAYOUT LENGTH 4 9/16" c. THIS ALLOWS 1/16" FOR CUTTING AND SHAPING d. MARK STOCK WITH SCRIBE 5. SCRIBE LINE FOR LENGTH OF STOCK a. LAY THE HEAD OF SQUARE ALONG LENGTH OF STOCK b. LAY BLADE OF SQUARE ACROSS STOCK ADJACENT TO THE SCRIBED LENGTH MARK

2. LAYOUT (CON'T.)		c. MARK METAL WITH SCRIBE ALONG EDGE OF BLADE
	6.	RECHECK FOR PROPER LENGTH
3. CLAMP STOCK	1.	LOWER SAW BLADE TO WORK TABLE
	2.	CHECK VISE FOR SQUARE WITH SAW BLADE
		a. USE SQUARE
		b. OPEN VISE JAWS TO ACCOMMODATE LENGTH OF COMBINATION SQUARE BLADE
		c. SLIDE HEAD OF SQUARE TO END OF BLADE WITH SQUARE SIDE TO OUTSIDE
		d. PLACE THE FLAT SIDE OF SQUARE HEAD AGAINST STATIONARY VISE JAW
		e. PLACE OUTSIDE EDGE OF SQUARE BLADE AGAINST SAW BLADE
		f. ADJUST THE VISE AS NEEDED TO SQUARE IT WITH THE BLADE
	3.	RAISE SAW BLADE
	4.	PLACE STOCK IN VISE
	5.	SUPPORT THE LONG END WITH FLOOR STAND
	6.	ADJUST VISE LOOSELY AGAINST STOCK
	7.	LOWER SAW BLADE UNTIL IT JUST CLEARS THE WORK
	8.	ENGAGE RATCHET LEVER AND KEEP SAW BLADE IN POSITION
	9.	HORIZONTAL BANDSAW ONLY--ADJUST ROLLER GUIDE BRACKETS UNTIL THEY JUST CLEAR MATERIAL TO BE SAWED
	10.	HOLD END OF STEEL RULE AGAINST SAW BLADE, MOVE MATERIAL UNTIL CORRECT LENGTH IS OBTAINED
	11.	CLAMP THE WORK FIRMLY WITH VISE
4. SAW MATERIAL	1.	PUT ON GOGGLES OR SAFETY GLASSES
	2.	RAISE THE SAW BLADE SLIGHTLY, DISENGAGE RATCHET LEVER
	3.	START SAW
	4.	LOWER SAW BLADE SLOWLY UNTIL IT TOUCHES WORK
	5.	START CUTTING OIL

4. SAW MATERIAL (CON'T.)	6. ALLOW SAW TO CUT METAL 7. LET DROP-OFF FALL TO FLOOR OR WORK BENCH CAUTION: DROP-OFF IS NOT TO BE CAUGHT WITH THE HANDS BECAUSE OF HOT METAL AND BURRS NOTE: WHEN WORK HAS BEEN COMPLETED SAW SHOULD CUT OFF AUTOMATICALLY 8. STOP CUTTING OIL FLOW 9. RAISE SAW BLADE AND POSITION WITH RATCHET STOP 10. LOOSEN VISE AND REMOVE STOCK 11. RETURN STOCK TO STORAGE
5. REMOVE BURRS	1. SELECT THE SMOOTH MILL FILE WITH HANDLE ON TANG 2. CLAMP WORK PIECE IN VISE a. AT ELBOW HEIGHT b. SAWED END UP 3. HOLD HANDLE OF FILE IN ONE HAND, HANDLE TOWARD BODY 4. GRASP END OF FILE BETWEEN THUMB AND TWO FINGERS 5. HOLD FILE FLAT AND SQUARE TO WORK PIECE 6. REMOVE THE BURRS BY PUSHING FILE ACROSS WORK PIECE END a. APPLY PRESSURE ON FORWARD CUTTING STROKE b. RELEASE PRESSURE ON RETURN STROKE NOTE: ONLY BURRS ARE TO BE REMOVED FROM WORK PIECE AT THIS TIME 7. REVERSE WORK PIECE IN VISE AND REMOVE BURRS FROM THIS END
6. CLEAN WORK STATION	1. BRUSH CHIPS FROM SAW WITH BENCH BRUSH 2. WIPE EXCESS OIL FROM SAW WITH CLEAN RAG 3. SWEEP UP CHIPS ON FLOOR

6. CLEAN WORK STATION (CON'T.)	4. SWEEP CHIPS INTO SCOOP AND DEPOSIT CHIPS IN TRASH BARREL 5. CLEAN OIL FROM FLOOR

ROUTE WORK PIECE TO BENCH

SKETCHES: DRAWING #1: CLAMP STRAP

REFERENCES: REF. #1, "POWER SAW", PP. 35-1 TO 35-6
"FILING", PP. 17-1 TO 17-7
REF. #2, "POWER HACKSAW", PP. 90-93
"FILING", PP. 113-117

B-1a

JOB SHEET
IN
BENCH WORK

JOB: MAKE CLAMP STRAP

MATERIALS: CUTTING OIL, CHALK, COLD ROLLED FLAT STOCK STEEL, ONE PIECE 1/2" X 2" X 4 9/16"

TOOLS AND EQUIPMENT: HAMMER, COMBINATION SQUARE, CENTER PUNCH, SCRIBE, SMOOTH MILL FILE, BENCH VISE, FILE CARD, DOUBLE SQUARE, BRUSH

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, "LAYOUT", 6-1 TO 6-10. PRACTICE SAFE WORKING HABITS AT ALL TIMES.

PROCEDURES AND/OR TASKS:

B-1a-1	SQUARE ENDS OF WORK PIECE
B-1a-2	LAYOUT WORK PIECE TO SPECIFICATIONS
B-1a-3	CENTER PUNCH WORK PIECE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. SELECTION OF TOOLS, SAFE AND CRAFTSMANLIKE CONDITION.
2. WORK PIECE SQUARE AND HELD TO PRINT SPECIFICATIONS.
3. WORK PIECE LAID OUT ACCORDING TO PRINT SPECIFICATIONS.
4. WORK STATION CLEAN AND IN PROFESSIONAL ORDER.

TASK SHEET

JOB: B-1a
TASK: 1
PAGE: 1

TASK: SQUARE ENDS OF WORK PIECE
JOB: MAKE CLAMP STRAP
TRADE: MACHINIST
TOOLS AND MATERIALS: VISE, 10" SMOOTH MILL FILE WITH HANDLE, DOUBLE SQUARE, FILE CARD AND BRUSH, CHALK, SCRIBE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. PREPARE VISE	1. LOOSEN VISE UNTIL JAWS ARE APPROXIMATELY 1" APART 2. PAD VISE JAWS TO PROTECT WORK PIECE, USE ANY ONE a. VISE JAW CAPS b. WOOD c. SHIM STOCK
2. POSITION WORK	1. PLACE WORK PIECE BETWEEN VISE JAWS, FLAT SIDE TO JAWS 2. ONE END UP 3. MOUNT WORK PIECE WITH END ABOUT 1" ABOVE TOP OF VISE JAWS 4. TOP OF WORK PIECE SHOULD BE SLIGHTLY BELOW ELBOW HEIGHT
3. POSITION BODY	1. TO FILE WORK PIECE 2. STAND FACING WORK WITH BODY AT ABOUT 30° ANGLE WITH FILING STROKE 3. STAND WITH ONE FOOT AHEAD OF THE OTHER DEPENDING ON THE WORKING HAND 4. ARCH OF SECOND FOOT SHOULD BE APPROXIMATELY 12" BEHIND FRONT FOOT 5. POINT FRONT FOOT TOWARD BENCH 6. STANDING DISTANCE FROM THE WORK PIECE SHOULD BE COMFORTABLE ACCORDING TO LENGTH OF ARMS
4. FILE WORK PIECE	1. USE 10" SMOOTH MILL FILE WITH HANDLE

4. FILE WORK PIECE (CON'T.)	2. GRASP THE FILE HANDLE IN WORKING HAND THUMB ON TOP OF HANDLE 3. PLACE PALM OF OTHER HAND ON TOP OF FILE AT POINT WITH THE FINGER PRESSED ON UNDERSIDE OF POINT 4. PLACE FILE FLAT ON WORK PIECE AS CLOSE TO POINT OF FILE AS FINGERS WILL ALLOW 5. KEEP FILE LEVEL ON WORK 6. MAKE CUTS WITH FILE BY PRESSING DOWN ON FORWARD STROKE AND LIFTING ON RETURN STROKE 7. WHEN FILING USE FULL LENGTH OF FILE NOTE: THERE IS ONLY 1/16" OF EXCESS METAL FOR SQUARING BOTH ENDS OF THE WORK PIECE, EXERCISE CAUTION AND LEAVE APPROXIMATELY 1/32" EXCESS METAL TO SQUARE OPPOSITE END 8. REMOVE CORRECT AMOUNT OF METAL
5. CHECK WORK	1. TEST WORK PIECE END FOR FLATWORK a. USE STRAIGHT EDGE b. LAY THE EDGE OF STRAIGHT EDGE PARALLEL ON AND TO THE WORK PIECE END c. SIGHT BETWEEN STRAIGHT EDGE AND WORK PIECE END NOTE: WORK PIECE END IS TO BE FLAT AND LEVEL WITH NO WAVES 2. TEST WORK PIECE END FOR SQUARE a. USE DOUBLE SQUARE b. LAY BLADE OF SQUARE ACROSS WORK PIECE END WIDTH c. LAY HEEL OF THE SQUARE ALONG LENGTH OF WORK PIECE, FIRM CONTACT d. SIGHT BETWEEN BLADE AND END OF WORK PIECE NOTE: END OF WORK PIECE IS TO BE SQUARE WITH SIDES

6. SQUARE OPPOSITE END	1. OF WORK PIECE 2. HOLD TO 4 1/2" TOTAL LENGTH OF WORK PIECE 3. REPEAT STEPS 4 AND 5 4. CHECK WORK PIECE AGAINST SPECIFICATIONS. USE DRAWING #1
7. CLEAN WORK PIECE	1. REMOVE WORK PIECE FROM VISE 2. USE CLEAN RAG 3. WIPE OFF OIL
8. CLEAN FILE	1. USE FILE CARD, BRUSH, AND SCRIBE 2. IN CASE OF PINNING, USE SCRIBE POINT TO REMOVE PARTICLES FROM FILE 3. RUB FILE CARD IN DIRECTION OF CUTS IN FILE UNTIL FILE CUTS ARE CLEAR 4. USE BRUSH TO FINISH CLEANING FILE 5. RUB CHALK OVER FILE BLADE 6. RETURN FILE TO PROPER STORAGE
9. CLEAN WORK STATION	1. USE BENCH BRUSH, BROOM, CLEAN RAGS, AND SCOOP 2. BRUSH OFF BENCH AND VISE 3. WIPE VISE CLEAN WITH CLEAN RAGS 4. SWEEP FLOOR 5. PICK UP SWEEPINGS IN SCOOP 6. PLACE SWEEPINGS IN A WASTE CONTAINER

SKETCHES: DRAWING #1: CLAMP STRAP

REFERENCES: REF. #1, PP. 17-1 TO 17-7
REF. #2, PP. 113-117

TASK SHEET

JOB: B-1a
TASK: 2
PAGE: 1

TASK: LAYOUT WORK PIECE TO SPECIFICATIONS

JOB: MAKE CLAMP STRAP

TRADE: MACHINIST

TOOLS AND MATERIALS: COMBINATION SQUARE, SCRIBE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. DETERMINE CENTER OF 5/8" HOLES	
A. SCRIBE CENTER LINE	1. ON WORK PIECE
	2. SET COMBINATION SQUARE FOR 1"
	3. LAY WORK PIECE FLAT ON WORK BENCH
	4. ONE END TOWARD BODY
	5. PLACE FLAT SIDE OF SQUARE HEAD AGAINST SIDE OF WORK PIECE AT END AWAY FROM BODY, BLADE OF SQUARE FLAT ON WORK PIECE
	6. POSITION THE SCRIBE FIRMLY AGAINST END OF BLADE NOTE: WITH BLADE ADJUSTED FOR 1" SCRIBE AT END OF BLADE SHOULD BE IN CENTER OF WORK PIECE NOTE: HOLD SQUARE, SCRIBE, AND WORK PIECE FIRMLY IN POSITION
	7. STARTING AT END OF WORK PIECE AWAY FROM BODY a. SCRIBE LINE LENGTH OF WORK PIECE b. BY PULLING SQUARE AND SCRIBE LENGTH OF WORK PIECE
B. LOCATE CENTER OF FIRST HOLE	1. SQUARE SET ON 1"
	2. WORK PIECE FLAT ON WORK BENCH
	3. WORK PIECE SIDE TOWARD BODY
	4. POSITION HEAD OF SQUARE AGAINST RIGHT END OF WORK PIECE 1" BLADE

B. LOCATE CENTER OF FIRST HOLE (CON'T.)	END PROTRUDING OVER WORK PIECE
	5. PLACE SCRIBE AT END OF SQUARE BLADE AT SIDE AWAY FROM BODY
	6. HOLD THE SQUARE, WORK PIECE, AND SCRIBE FIRMLY
	7. SCRIBE LINE ACROSS WORK PIECE NOTE: WHERE CENTER LINE AND NEW LINE INTERSECT IS THE POSITION OF FIRST 5/8" HOLE
C. LOCATE CENTER OF SECOND HOLE	1. SET SQUARE FOR 2 1/4"
	2. POSITION HEAD OF SQUARE AGAINST SAME END OF WORK PIECE
	3. SCRIBE SECOND LINE ACROSS WORK PIECE NOTE: THE TWO LINES ACROSS WORK PIECE SHOULD BE 1 1/4" APART, SECOND LINE INTERSECTION WITH CENTER LINE IS LOCATION OF SECOND 5/8" HOLE
2. DETERMINE CENTERS FOR 1/4" HOLES	
A. SCRIBE CENTER LINES	1. FOR FIRST TWO HOLES
	2. TURN WORK PIECE WITH ONE END TOWARD BODY
	3. SET COMBINATION SQUARE FOR 1 3/16"
	4. POSITION HEAD OF SQUARE AGAINST RIGHT EDGE OF WORK PIECE
	5. POSITION SCRIBE a. AT END OF BLADE ON WORK PIECE b. ON LINE CROSSING WORK PIECE FROM SIDE TO SIDE FARTHEST FROM BODY
	6. SCRIBE LINE BETWEEN TWO LINES CROSSING WORK PIECE
	7. TURN WORK PIECE AROUND SO SECOND END WILL BE NEXT TO BODY
	8. REPEAT KEY POINTS 2 THROUGH 6 OF THIS STEP
B. LOCATE CENTER OF FIRST TWO 1/4" HOLES	1. SET COMBINATION SQUARE FOR 1 3/8"
	2. TURN WORK PIECE WITH SAME SIDE TOWARD BODY AS THE 5/8" HOLES WERE SCRIBED

B. LOCATE CENTER OF FIRST TWO 1/4" HOLES (CON'T.)	3. PLACE HEAD OF SQUARE AGAINST SAME END USED TO SCRIBE 5/8" HOLES WITH BLADE PROTRUDING OUT OVER WORK PIECE 4. POSITION THE SCRIBE AGAINST END OF BLADE ON WORK PIECE 5. SCRIBE THE LINE ACROSS BOTH LINES SCRIBED IN STEP 2A
C. LOCATE CENTER OF THIRD AND FOURTH HOLES	1. WORK PIECE IN SAME POSITION 2. SET COMBINATION SQUARE ON 1 7/8" 3. PLACE HEAD OF SQUARE AGAINST SAME END WITH BLADE OVER WORK PIECE 4. PLACE SCRIBE AGAINST END OF BLADE ON WORK PIECE 5. SCRIBE SECOND LINE ACROSS LINES SCRIBED IN STEP 2A NOTE: THE LOCATION OF SIX HOLES SHOULD NOW HAVE BEEN LOCATED ON THE WORK PIECE, TWO 5/8" AND FOUR 1/4"
3. CHECK LAYOUT	1. USE COMBINATION SQUARE 2. SET THE SQUARE ON EACH DIMENSION CALLED FOR IN THIS TASK, ONE AT A TIME 3. CHECK SCRIBED LINES AND LOCATION OF HOLE CENTERS FOR PROPER LOCATION 4. CLEAN SCRIBE AND SQUARE AND RETURN TO STORAGE

SKETCH: DRAWING #1: CLAMP STRAP

REFERENCES: REF. #1, PP. 6-1 TO 6-10
REF. #2, PP. 62-66

TASK SHEET

JOB: B-1a
TASK: 3
PAGE: 1

TASK: CENTER PUNCH WORK PIECE

JOB: MAKE CLAMP STRAP

TRADE: MACHINIST

TOOLS AND MATERIALS: HAMMER, CENTER PUNCH

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SELECT AND INSPECT CENTER PUNCH	1. POINT a. SHARP b. ANGLE 30° 2. CHECK HEAD FOR MUSHROOM 3. REMOVE MUSHROOM FROM HEAD BY GRINDING IF NECESSARY
2. SELECT AND INSPECT HAMMER	1. 16 OZ. BALL PEEN 2. HANDLE TIGHT IN HEAD 3. FACE OF FLAT PEEN a. NO CRACKS b. NO CHIPS c. CLEAN 4. HANDLE NOT CRACKED OR SPLIT
3. CENTER PUNCH	1. LAY WORK PIECE ON CLEAN SOLID WORK BENCH SCRIBED SIDE UP 2. HOLD CENTER PUNCH FIRMLY IN HAND POINT DOWN 3. PUNCH HEAD NO LESS THAN 1" ABOVE HAND 4. PLACE POINT OF CENTER PUNCH a. ON INTERSECTION OF THE LAYOUT LINES FOR A HOLE b. ON WORK PIECE c. LEAN PUNCH SIDEWAYS SLIGHTLY IN ORDER TO OBSERVE POINT AND LINE INTERSECTION FOR PLACEMENT OF PUNCH NOTE: MAKE SURE POINT OF PUNCH IS PRECISELY ON POINT WHERE LINES CROSS

3. CENTER PUNCH (CON'T.)	5. HOLD PUNCH FIRMLY AGAINST AND VERTICAL TO WORK PIECE 6. PICK UP HAMMER IN CENTER OF HANDLE GRIP FLAT PEEN DOWN 7. TAP PUNCH HEAD GENTLY WITH HAMMER 8. REPEAT KEY POINTS 2 THROUGH 7 FOR EACH HOLE
4. INSPECT CENTER PUNCH MARKS	1. PUNCH MARK EXACTLY WHERE LINES CROSS 2. PUNCH MARKS ARE SHARP AND CLEAR 3. CHECK LAYOUT AGAINST SPECIFICATIONS

ROUTE WORK PIECE TO DRILL PRESS

SKETCH: DRAWING #1, CLAMP STRAP

REFERENCE: REF. #2, PP. 215-216

JOB SHEET
IN
DRILL PRESS

JOB: MAKE CLAMP STRAP

MATERIALS: WORK PIECE 1/2" X 2" X 4 1/2" WITH PROPER LAYOUT AND CENTER PUNCH

TOOLS AND EQUIPMENT: DRILL PRESS, DRILL PRESS VISE, DRILL CHUCK AND KEY, 1/4" STRAIGHT SHANK DRILL, 5/8" TAPER SHANK DRILL, DRILL DRIFT, SMOOTH MILL FILE, PARALLELS

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, PP. 34-1 TO 34-24 AND REF. #2, PP. 203-228. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE. PRACTICE SAFE WORKING HABITS.

PROCEDURES AND/OR TASKS:

DP-1-1	CHECK DRILL PRESS FOR OPERATION
DP-1-2	SHARPEN DRILL BIT
DP-1-3	DRILL 1/4" HOLES IN WORK PIECE
DP-1-4	DRILL 5/8" HOLES IN WORK PIECE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. DRILL PRESS IN PROPER WORKING ORDER.
2. CORRECT SET UP FOR DRILLING 1/4" HOLES.
3. 1/4" HOLES DRILLED TO SPECIFICATION.
4. CORRECT SET UP FOR DRILLING 5/8" HOLES.
5. 5/8" HOLES DRILLED TO SPECIFICATION.
6. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MATERIALS, AND STANDARDS.

TASK SHEET

JOB: DP-1
TASK: 1
PAGE: 1

TASK: CHECK DRILL PRESS FOR OPERATION
JOB: MAKE CLAMP STRAP
TRADE: MACHINIST
TOOLS AND MATERIALS: DRILL PRESS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOTOR	1. PROPERLY GROUNDED 2. ON AND OFF SWITCH FUNCTIONS PROPERLY 3. MOTOR OPERATES SMOOTHLY
2. TABLE	1. PROPER HEIGHT 2. LEVEL 3. LOCKED IN PLACE 4. CLEAN
3. SPEED	1. SELECT PROPER SPEED, 400 RPM 2. PROPER BELT TENSION 3. PULLEY COVERS OR GUARDS IN PLACE
4. FEED	1. FEED LEVER IN OPERATION 2. DEPTH STOP PROPERLY ADJUSTED
5. LUBRICATION	1. OIL DAILY 2. ONE OR TWO DROPS IN EACH OIL HOLE
6. CHUCK	1. PROPERLY ATTACHED TO SPINDLE 2. TIGHT ON DRILL 3. REMOVE CHUCK KEY

SKETCH: DRAWING #1: CLAMP STRAP

REFERENCES: REF. #1, PP. 34-1 TO 34-22
REF. #2, PP. 203-228

TASK SHEET

JOB: DP-1
TASK: 2
PAGE: 1

TASK: SHARPEN DRILL BIT HAND METHOD

JOB: MAKE CLAMP STRAP

TRADE: MACHINIST

TOOLS AND MATERIALS: GRINDER, COARSE STONE, FINE STONE, DRILL POINT GAUGE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SELECT GRINDER WHEEL	1. ALL STONE WHEEL FACES MUST BE DRESSED SMOOTH AND SQUARE ACROSS GRINDING SURFACE 2. SELECT COARSE WHEEL FOR ROUGHING OUT DRILL POINT IN CASE MUCH METAL HAS TO BE GROUND OFF 3. COMPLETION OF SHARPENING JOB TO BE DONE WITH FINE WHEEL 4. NO CRACKS IN WHEELS
2. INSTALL GRINDER WHEEL	1. REMOVE FLANGE FROM SPINDLE 2. PLACE STONE ON SPINDLE NOTE: HOLE IN WHEEL MUST BE OF CORRECT SIZE. WHEEL IS NOT TO BE FORCED ON SPINDLE. 3. STONE WHEEL BLOTTER RINGS (COMPRESSION WASHERS) LARGE ENOUGH TO EXTEND BEYOND EDGES OF SPINDLE FLANGES 4. INSTALL FLANGE ON SPINDLE 5. INSTALL SPINDLE NUT AND TIGHTEN SECURELY CAUTION: MAKE SURE WHEEL IS FIRM AGAINST FLANGE ALL AROUND
3. POSITION GRINDER TOOL REST	1. ADJUST TOOL REST FOR 1/16" CLEARANCE FROM CUTTING FACE OF THE GRINDER WHEEL 2. ADJUST TOOL REST TO SLIGHTLY BELOW CENTER LINE OF GRINDER WHEEL

3. POSITION GRINDER TOOL REST (CON'T.)	3. TIGHTEN TOOL REST FIRMLY IN POSITION
4. HOLD DRILL BIT	1. HOLD SHANK OF DRILL BIT IN RIGHT HAND 2. HOLD CENTER OF DRILL BIT IN LEFT HAND NOTE: LEFT HAND IS TO ACT AS PIVOT POINT FOR DRILL BIT 3. PLACE FINGERS OF LEFT HAND, HOLDING DRILL BIT, ON TOOL REST 4. STAND SO CENTER LINE OF DRILL BIT WILL BE AT A 59 DEGREE ANGLE WITH CENTER LINE OF GRINDER WHEEL
5. GRIND DRILL BIT	1. PUT ON FACE SHIELD 2. TURN ON GRINDER 3. HOLD DRILL BIT AS DESCRIBED IN STEP 4 4. LIGHTLY TOUCH DRILL BIT LIP TO GRINDER WHEEL IN APPROXIMATELY A HORIZONTAL POSITION 5. USE LEFT HAND AS PIVOT POINT a. SLOWLY LOWER SHANK END OF DRILL BIT WITH RIGHT HAND AND ROTATE BIT b. INCREASE PRESSURE AS BIT IS ROTATED TO HEEL TO CREATE PROPER CLEARANCE FOR LIP 6. USE DRILL POINT GAUGE TO CHECK GROUND SIDE OF TIP a. LAY LONG SIDE OF GAUGE ALONG LENGTH OF DRILL b. FIT OVER ANGLE OF POINT c. GRIND POINT TO CONFORM TO ANGLE OF GAUGE 7. REPEAT GRINDING PROCEDURE FOR SECOND LIP 8. REPEAT PROCEDURE UNTIL DRILL BIT IS SHARP 9. CHECK DRILL END WITH GAUGE FREQUENTLY CAUTION: DRILL BIT IS NOT TO BE COOLED BY QUENCHING IN WATER. COOL BIT AT ROOM TEMPERATURE IN

5. GRIND DRILL BIT (CON'T.)	CALM AIR 10. TURN OFF GRINDER
6. CLEAN WORK STATION	1. REMOVE GRINDER WHEEL 2. BRUSH OFF GRINDER 3. SWEEP UP GRINDER DUST AND DEPOSIT IN WASTE CONTAINER 4. CLEAN DRILL BIT AND GAUGE AND RETURN TO STORAGE

TASK SHEET

JOB: DP-1
TASK: 3
PAGE: 1

TASK: DRILL 1/4" HOLES IN WORK PIECE

JOB: MAKE CLAMP STRAP

TRADE: MACHINIST

TOOLS AND MATERIALS: DRILL PRESS, DRILL PRESS VISE, 1/4" STRAIGHT SHANK DRILL BIT, PARALLELS, OIL

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SELECT AND INSPECT DRILL BIT	1. STRAIGHT SHANK DRILL BIT
	2. CLEAN AND FREE OF SCRATCHES AND NICKS, FOR PROPER FIT IN CHUCK
	3. BIT IS SHARP
	4. THE POINT IN GOOD CONDITION AND GROUND TO CORRECT ANGLE
2. INSTALL DRILL BIT	1. IN DRILL PRESS CHUCK
	2. INSERT DRILL BIT SHANK 1" INTO CHUCK
	3. TIGHTEN CHUCK, USE CHUCK KEY NOTE: ROTATE CHUCK BY HAND, USE CHUCK KEY IN ALL THREE HOLES OF CHUCK FOR EVEN GRIP OF CHUCK ON DRILL BIT SHANK
	4. REMOVE CHUCK KEY FROM CHUCK AND PLACE IN CORRECT STORAGE
3. SET SPEED	1. DRILL PRESS
	2. DRILL PRESS EQUIPPED WITH CONTROL MECHANISM DIAL REQUIRED SPEED
	3. DRILL PRESS EQUIPPED WITH STEP PULLEY SPEED CONTROL a. CHECK SPECIFICATIONS FOR PULLEY RATIOS b. POSITION BELT ON PROPER PULLEYS c. SET RPM FOR APPROXIMATELY 400
4. MOUNT WORK	1. PLACE TWO PARALLEL BARS IN DRILL PRESS VISE

4. MOUNT WORK (CON'T.)	2. PLACE WORK PIECE ON PARALLEL BARS PUNCH MARKS UP NOTE: BE SURE DRILL BIT WILL NOT HIT PARALLEL BARS 3. TIGHTEN VISE ON WORK PIECE 4. ADJUST WORK PIECE SO 1/4" HOLE PUNCH MARK IS UNDER POINT OF DRILL BIT 5. LOWER DRILL BIT TO WORK PIECE AND CHECK FOR PROPER CONTACT WITH PUNCH MARK
5. DRILL FIRST HOLE	1. PUT ON GOGGLES OR SAFETY GLASSES 2. START DRILL PRESS MOTOR 3. ADVANCE DRILL SLOWLY UNTIL PUNCH MARK IS SLIGHTLY ENLARGED 4. RAISE DRILL BIT, CHECK FOR HOLE BEING STARTED IN PROPER LOCATION 5. USE LUBRICANT ON DRILL BIT a. BRUSH ON AS DRILLING STARTS b. TO WASH AWAY CHIPS c. TO KEEP BIT COOL 6. ADVANCE DRILL SLOWLY THROUGH WORK PIECE CAUTION: EXERCISE CARE NOT TO LET WORK PIECE CLIMB DRILL BIT 7. DECREASE PRESSURE ON FEED AS DRILL BEGINS TO BREAK THROUGH UNDERSIDE OF WORK PIECE CAUTION: STOP DRILL PRESS MOTOR IF WORK PIECE BEGINS TO CLIMB DRILL BIT, REMOVE WORK PIECE FROM DRILL BIT 8. WITH LIGHT DOWN FEED OF DRILL BIT COMPLETE HOLE
6. DRILL THREE REMAINING HOLES	1. REPEAT KEY POINTS 4 AND 5 OF STEP 3 2. REPEAT STEP 4 3. TURN OFF DRILL PRESS 4. REMOVE 1/4" DRILL BIT FROM CHUCK, CLEAN, AND RETURN TO STORAGE

SKETCH: DRAWING #1, CLAMP STRAP

REFERENCES: REF. #1, PP. 34-1 TO 34-24
REF. #2, PP. 215-219

TASK SHEET

JOB: DP-1
TASK: 4
PAGE: 1

TASK: DRILL 5/8" HOLES IN WORK PIECE

JOB: MAKE CLAMP STRAP

TRADE: MACHINIST

TOOLS AND MATERIALS: DRILL PRESS, 5/8" TAPERED SHANK DRILL BIT, DRILL BIT, SMOOTH MILL FILE, OIL

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SELECT DRILL BIT	1. TAPERED SHANK 2. SHANK CLEAN AND FREE OF NICKS AND SCRATCHES 3. BIT IS SHARP WITH POINT IN GOOD SHAPE AND GROUND TO CORRECT ANGLE
2. INSTALL DRILL BIT	1. REMOVE CHUCK a. FROM SPINDLE b. USE DRILL DRIFT NOTE: CHUCK IS NOT TO DROP ON TABLE OR FLOOR, CATCH 2. ALIGN TANG OF 5/8" DRILL BIT WITH SLOT IN SPINDLE 3. FASTEN DRILL BIT IN SPINDLE WITH QUICK FIRM UPWARD THRUST
3. SET SPEED	1. DRILL PRESS 2. DRILL PRESS EQUIPPED WITH CONTROL MECHANISM DIAL REQUIRED SPEED 3. DRILL PRESS EQUIPPED WITH STEP PULLEY SPEED CONTROL a. CHECK SPECIFICATIONS FOR PULLEY RATIOS b. POSITION BELT ON PROPER PULLEYS c. SET RPM FOR APPROXIMATELY 200
4. MOUNT WORK	REPEAT STEP 3 OF DP-1-3
5. DRILL HOLES	REPEAT STEP 4 OF DP-1-3
6. REMOVE BURRS	1. FROM WORK PIECE

6. REMOVE BURRS (CON'T.)	2. REMOVE WORK PIECE FROM VISE CAUTION: WORK PIECE WILL BE HOT 3. ALLOW WORK PIECE TO COOL 4. TURN SCRIBED SIDE OF WORK PIECE DOWN 5. HOLD WORK PIECE IN PALM OF HAND BURRS UP AND AT AN ANGLE 6. USE 10" SMOOTH MILL FILE WITH HANDLE 7. PUSH FILE LIGHTLY OVER BURRS
7. CLEAN WORK STATION	1. REMOVE DRILL BIT FROM SPINDLE 2. USE DRILL DRIFT IN SLOT OF SPINDLE CAUTION: DRILL BIT IS NOT TO DROP, CATCH 3. CLEAN DRILL BIT, DRIFT, FILE, AND VISE AND RETURN TO STORAGE 4. INSTALL CHUCK IN SPINDLE WITH QUICK UPWARD THRUST 5. BRUSH OFF DRILL 6. SWEEP UP CHIPS AND DEPOSIT IN WASTE CONTAINER

ROUTE WORK PIECE TO BENCH FOR COMPLETION

SKETCH: DRAWING #1: CLAMP STRAP

REFERENCES: REF. #1, PP. 34-1 TO 34-24
REF. #2, PP. 215-219

B-1b

JOB SHEET
IN
BENCH WORK

JOB: MAKE CLAMP STRAP

MATERIALS: WORK PIECE 1/2" X 2" X 4 1/2" COLD ROLLED FLAT STOCK STEEL

TOOLS AND EQUIPMENT: BENCH PLATE, BENCH VISE, HAMMER, FLAT COLD CHISEL, 10" MILL FILE, OUTSIDE CALIPER, ABRASIVE CLOTH (120 GRIT), HAND HACKSAW, GRINDER, COMBINATION SQUARE WITH PROTRACTOR HEAD

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, PP. 17-1 TO 17-7 AND REF. #2, PP. 107-117. CHECK WITH INSTRUCTOR AT FREQUENT INTERVALS. PRACTICE SAFE WORKING HABITS.

PROCEDURES AND/OR TASKS:

B-1b	SHARPEN FLAT COLD CHISEL
B-2b	REMOVE EXCESS STOCK FROM SLOT
B-3b	FILE ELONGATED SLOT TO SCRIBE LINES
B-4b	POLISH
B-5b	INSPECT

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. HOLD TO ALL BLUEPRINT DIMENSIONS.
2. ALL FLAT SURFACES ARE SQUARE AND PARALLEL.
3. FINISH MEETS STANDARDS REQUIRED (SMOOTH).
4. CORRECT SETUP.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: B-1b
TASK: 1
PAGE: 1

TASK: SHARPEN FLAT COLD CHISEL

JOB: MAKE CLAMP STRAP

TRADE: MACHINIST

TOOLS AND MATERIALS: FLAT COLD CHISEL, GRINDER, FINE OR MEDIUM GRINDER WHEEL, COMBINATION SQUARE WITH PROTRACTOR HEAD

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP GRINDER	1. INSTALL FINE OR MEDIUM GRINDER WHEEL a. WHEEL TO BE SOUND b. CUTTING FACE DRESSED SQUARE c. SECURELY FASTENED TO SPINDLE 2. ADJUST TOOL REST a. SLIGHTLY BELOW CENTER LINE OF GRINDER WHEEL b. 1/16" CLEARANCE FROM GRINDING FACE OF WHEEL c. USE PROTRACTOR AND SET AT 60 DEGREE ANGLE
2. SHARPEN CHISEL	1. PUT ON GOGGLES OR SAFETY GLASSES 2. LAY CUTTING END OF CHISEL ON TOOL REST FACING CUTTING FACE OF THE GRINDER WHEEL, ONE SIDE DOWN 3. HOLD HEAD OF CHISEL WITH ONE HAND 4. TURN ON GRINDER 5. PLACE FINGERS OF OTHER HAND ON TOP OF CHISEL TO HOLD FLAT AGAINST TOOL REST 6. LIGHTLY MOVE CHISEL CUTTING EDGE INTO GRINDER WHEEL 7. COOL CHISEL FREQUENTLY BY DIPPING IN WATER 8. GRIND FIRST ONE SIDE OF CUTTING EDGE AND THEN THE OTHER 9. MOVE CHISEL HEAD FROM SIDE TO SIDE A LITTLE DURING GRINDING TO CURVE CUTTING EDGE VERY SLIGHTLY

2. SHARPEN CHISEL (CON'T.)	10.	TURN CHISEL OVER TO GRIND SECOND BEVEL
	11.	KEEP BEVELS THE SAME WIDTH TO KEEP CUTTING EDGE IN CENTER
	12.	TURN OFF GRINDER
	13.	CLEAN WORK STATION

TASK SHEET

JOB: B-1b
TASK: 2
PAGE: 1

TASK: REMOVE EXCESS STOCK FROM SLOT

JOB: MAKE CLAMP STRAP

TRADE: MACHINIST

TOOLS AND MATERIALS: BENCH PLATE, FLAT COLD CHISEL, HAMMER, BENCH VISE, HAND HACKSAW

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SELECT AND INSPECT COLD CHISEL	1. INSPECT CHISEL POINT a. CORRECT ANGLE 60 DEGREES b. SHARP
	2. GRIND OFF MUSHROOM HEAD IF NECESSARY
2. FLAT COLD CHISEL METHOD	1. PUT ON SAFETY GOGGLES OR GLASSES
	2. LAY WORK PIECE FLAT ON BENCH PLATE SCRIBED SIDE UP
	3. HOLD CHISEL LOOSELY IN ONE HAND HEAD ABOUT 1" ABOVE HAND
	4. GRASP HAMMER HANDLE NEAR END WITH OTHER HAND, HOLD HAMMER LOOSELY TO KEEP FROM TIRING
	5. HOLD CHISEL WORK TO LAYOUT LINE
	6. HOLD CHISEL ON WORK PIECE IN POSITION TO MAKE PROPER SIZE CHIP
	7. STRIKE CHISEL SQUARELY ON HEAD WITH SHARP BLOW
	8. RESET CHISEL AFTER EACH BLOW
	9. CONTINUE CHISEL WORK UNTIL EXCESS METAL IS REMOVED FROM SLOT
3. SELECT HAND HACKSAW	1. FRAME WITHOUT SAW BLADE INSTALLED
	2. SAW BLADE, PROPER SET, PROPER NUMBER OF TEETH, SHARP
4. HAND HACKSAW METHOD	1. MOUNT WORK PIECE IN VISE SLOT AT TOP
	2. USE PROTECTIVE VISE CAPS, SHIM STOCK, OR WOOD ON VISE JAWS TO

4. HAND HACKSAW METHOD (CON'T.)

PROTECT WORK PIECE
3. CLAMP WORK PIECE ON EDGES
4. INSERT SAW BLADE THROUGH SLOT
   a. TEETH POINTED AWAY FROM OPERATOR
   b. TEETH ON BOTTOM SIDE
5. ATTACH SAW BLADE TO FRAME
6. ADJUST TO PROPER TENSION
7. HOLD TO LAYOUT LINE
8. REMOVE EXCESS STOCK FROM WORK PIECE BY SAWING AROUND SLOT
9. REMOVE HACKSAW BLADE FROM SLOT, CLEAN AND RETURN TO STORAGE
10. REMOVE WORK PIECE FROM VISE
11. CLEAN WORK STATION

SKETCH: DRAWING #1: CLAMP STRAP

REFERENCES: REF. #1, PP. 8-1 TO 8-3
REF. #2, PP. 101-105

TASK SHEET

JOB: B-1b
TASK: 3
PAGE: 1

TASK: FILE SLOT TO SCRIBE LINES

JOB: MAKE CLAMP STRAP

TRADE: MACHINIST

TOOLS AND MATERIALS: BENCH VISE, 10" MILL FILE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK	1. OPEN BENCH VISE 3/4"
	2. PROTECT WORK PIECE WITH WOOD OR SHIM STOCK
	3. PLACE WORK PIECE IN VISE WITH SLOT EXPOSED
	4. BOTTOM SURFACE OF SLOT SLIGHTLY ABOVE AND PARALLEL TO VISE JAWS
	5. TIGHTEN VISE SLIGHTLY
2. FILE BOTTOM SIDE OF SLOT	1. USE 10" MILL FILE WITH HANDLE
	2. HOLD FILE HANDLE FIRMLY
	3. KEEP FILE AT RIGHT ANGLE TO FLAT SURFACE
	4. FILE BOTTOM OF SLOT TO LAYOUT LINES NOTE: THE EDGE OF FILE IS NOT TO STRIKE RADIUS OF SLOT DURING FILING OPERATION
	5. REMOVE WORK PIECE
3. FILE TOP SIDE OF SLOT	1. TURN WORK PIECE OVER IN VISE
	2. REPEAT STEPS 1 AND 2

SKETCH: DRAWING #1: CLAMP STRAP

REFERENCES: REF. #1, PP. 17-1 TO 17-7
REF. #2, PP. 113-117

TASK SHEET

JOB: B-1b
TASK: 4
PAGE: 1

TASK:	POLISH
JOB:	MAKE CLAMP STRAP
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ABRASIVE CLOTH (120 GRIT), OIL

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POLISH FIRST SIDE	1. LAY WORK PIECE FLAT ON TABLE
	2. SELECT SMALL PIECE 120 GRIT ABRASIVE CLOTH
	3. PLACE GRIT SURFACE ON WORK PIECE
	4. APPLY PRESSURE AND RUB CLOTH BACK AND FORTH IN STRAIGHT LINE PARALLEL TO EDGE OF WORK PIECE
	5. RUB WORK PIECE UNTIL ALL BLEMISHES ARE REMOVED NOTE: NEW ABRASIVE CLOTH WILL SCAR METAL WHEN FIRST USED. AS THE GRIT BREAKS DOWN A FEW DROPS OF OIL MAY BE USED TO PRODUCE A HIGH FINISH
2. POLISH SECOND SIDE	1. LAY RAG ON TABLE TO PROTECT POLISHED SIDE
	2. LAY WORK PIECE FLAT ON TABLE, POLISHED SIDE DOWN
	3. REPEAT STEP 1
3. POLISH EDGES	1. PLACE WORK PIECE ON ONE EDGE, POLISH TOP EDGE
	2. ROTATE AND POLISH UNTIL ALL EDGES ARE POLISHED
	3. WIPE WORK PIECE CLEAN
	4. CLEAN WORK AREA

SKETCH: DRAWING #1: CLAMP STRAP

REFERENCES: REF. #2, PP. 122-129

TASK SHEET

JOB: B-1b
TASK: 5
PAGE: 1

TASK: INSPECT

JOB: MAKE CLAMP STRAP

TRADE: MACHINIST

TOOLS AND MATERIALS: OUTSIDE CALIPER, STEEL RULE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. OVERALL SIZE	1. LENGTH 2. WIDTH 3. THICKNESS
2. SLOT	1. LENGTH 2. WIDTH 3. LOCATION
3. FINISH	POLISHED

SKETCH: DRAWING #1: CLAMP STRAP

REFERENCES: REF. #1, PP. 5-1 TO 5-2

MACHINE SHOP DRILL DRIFT

POWER HACKSAW	2
BENCH WORK	2
DRILL PRESS	2
SHAPER	1

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWINGS, AND CONSTRUCT A DRILL DRIFT ACCORDING TO SPECIFICATIONS; USING THE VARIOUS MACHINES, TOOLS, AND EQUIPMENT CALLED FOR IN THE JOB.

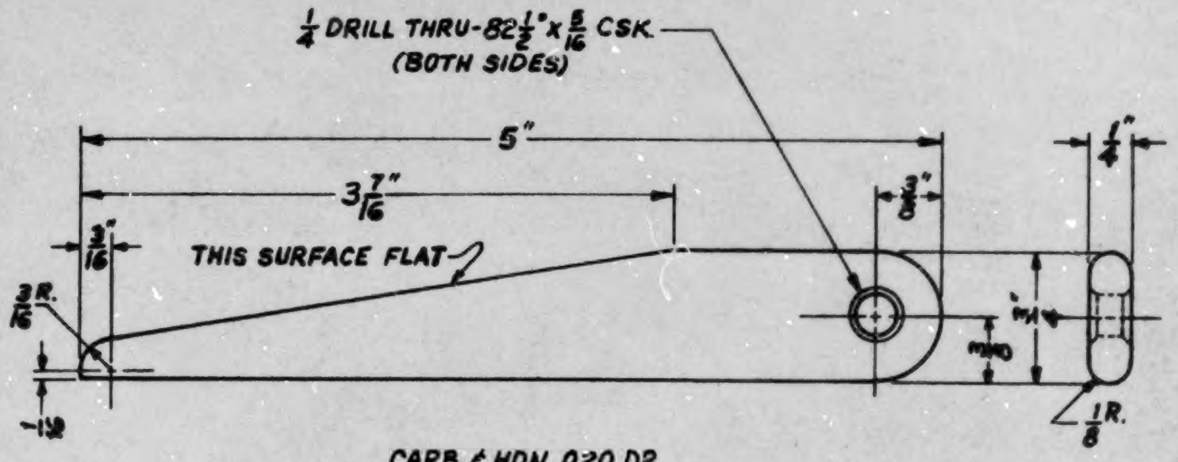
CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SETUP AND PREPARATION OF MACHINES FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING NO. 2.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

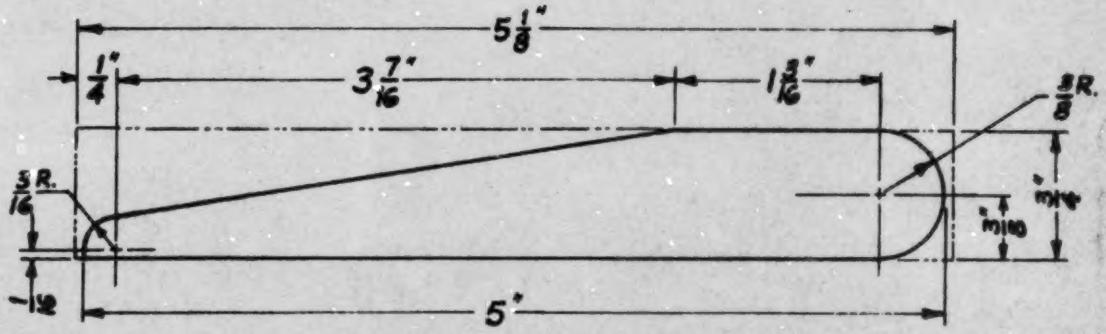
REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.


1/4 DRILL THRU-82½° x 5/16 CSK.
(BOTH SIDES)
5"
3 7/16"
3/16"
THIS SURFACE FLAT
3/16 R.
.12
3/8"
1/4"
3/4"
3/8"
1/8 R.

CARB. & HDN. .020 DP.

F.A.O.


5 1/8"
1/4"
3 7/16"
1 3/16"
3/8 R.
3/16 R.
3/4"
3/8"
.12
5"

LAYOUT DRAWING

DRAWING NO. 2	DRILL DRIFT	TOLERANCE CHART
POWER SAW 2 BENCH WORK 2 DRILL PRESS 2 SHAPER 1	MATERIAL: C.R.S. FINISH: FILE & POLISH SCALE: FULL SIZE	FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1/2°

B-2a

JOB SHEET
IN
BENCH WORK

JOB:	MAKE DRILL DRIFT	
MATERIALS:	ONE PIECE 1/4" X 3/4" X 5 1/8" COLD ROLLED FLAT STOCK STEEL	
TOOLS AND EQUIPMENT:	BENCH VISE, SMOOTH MILL FILE, COMBINATION SQUARE, SCRIBE, HAMMER, CENTER PUNCH, DIVIDERS, FILE CARD, BRUSH	
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB REFER TO CLAMP STRAP, JOB B-1a. READ RECOMMENDED REFERENCES BEFORE STARTING JOB. CHECK WITH INSTRUCTOR AT FREQUENT INTERVALS.	
PROCEDURES AND/OR TASKS:	B-2a-1	SQUARE ENDS OF WORK PIECE AND HOLD TO 5" LENGTH. REFER TO CLAMP STRAP, JOB B-1a, TASK 1
	B-2a-2	LAYOUT WORK PIECE TO SPECIFICATIONS
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.	

1. HOLD TO ALL PRINT SPECIFICATIONS.
2. ALL FLAT SURFACES ARE SQUARE AND PARALLEL.
3. RADII ARE HELD EVEN.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MACHINES, AND STANDARDS.
5. SAFE WORKING PROCEDURES.

JOB SHEET
IN
POWER HACKSAW

JOB:	MAKE DRILL DRIFT	
MATERIALS:	CUTTING OIL, COLD ROLLED FLAT STOCK STEEL, ONE PIECE 1/4" X 3/4" X 5 1/8"	
TOOLS AND EQUIPMENT:	POWER HACKSAW, MILL FILE, 6" RULE, SCRIBE	
GENERAL INSTRUCTIONS:	REFER TO JOB PH-1, CLAMP STRAP. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.	
PROCEDURES AND/OR TASKS:	PH-2-1	SET UP POWER HACKSAW FOR TASK AND CHECK FOR PROPER RUNNING CONDITION
	PH-2-2	CUT CR FLAT STOCK TO LENGTH
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.	

1. FLAT STOCK CUT TO 5 1/8" LENGTH.
2. CORRECT SETUP.
3. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MATERIALS, MACHINES, AND STANDARDS.

TASK SHEET

JOB: B-2a
TASK: 2
PAGE: 1

TASK: LAYOUT WORK PIECE TO SPECIFICATIONS

JOB: MAKE DRILL DRIFT

TRADE: MACHINIST

TOOLS AND MATERIALS: COMBINATION SQUARE, SCRIBE, DIVIDERS, HAMMER, CENTER PUNCH

TASK BREAKDOWN:

STEPS	KEY POINTS
1. DETERMINE CENTER LINE	1. OF WORK PIECE
	2. SET SQUARE ON 3/8"
	3. PLACE HEAD OF SQUARE ON SIDE OF WORK PIECE WITH 3/8" BLADE ON WORK PIECE AT ONE END
	4. SCRIBE WORK PIECE ALONG END OF SQUARE BLADE ON WORK PIECE
	5. SCRIBE PERPENDICULAR LINE ACROSS CENTER LINE
	6. PLACE HEAD OF SQUARE ON END OF WORK PIECE WITH SCRIBE MARK
	7. BLADE OF SQUARE OVER WORK PIECE 3/8"
	8. SCRIBE LINE FROM SIDE TO SIDE OF WORK PIECE AT END OF SQUARE BLADE
	9. INTERSECTION OF TWO LINES IS CENTER OF 1/4" HOLE
2. CENTER PUNCH	1. FOR 1/4" HOLE AT INTERSECTION OF SCRIBED LINES
	2. REFER TO CLAMP STRAP, JOB B-1a, TASK 3
3. LAYOUT 3/8" RADIUS	1. SET DIVIDERS ON 3/8"
	2. PLACE ONE LEG OF DIVIDERS IN CENTER PUNCH HOLE
	3. SCRIBE LINE ACROSS END OF WORK PIECE
4. DETERMINE CENTER OF 3/16" RADIUS	1. SET COMBINATION SQUARE ON 3/16"
	2. LAY HEAD OF SQUARE ALONG END OF

4. DETERMINE CENTER OF 3/16" RADIUS (CON'T.)	WORK PIECE 3. 3/16" BLADE ON WORK PIECE AT OPPOSITE END FROM CENTER PUNCH 4. SCRIBE LINE AT END OF BLADE ACROSS WORK PIECE 5. SET COMBINATION SQUARE ON 1/16" 6. SCRIBE CENTER LINE FOR RADIUS AS SHOWN IN DRAWING NO. 2 7. CENTER PUNCH VERY LIGHTLY
5. LAYOUT 3/16" RADIUS	1. SET DIVIDERS ON 3/16" 2. INSERT ONE LEG OF DIVIDERS IN CENTER PUNCH HOLE 3. SCRIBE ARC AS SHOWN IN DRAWING NO. 2
6. LAYOUT ANGLE	1. SET COMBINATION SQUARE ON 1 9/16" 2. PLACE HEAD OF SQUARE AGAINST END OF WORK PIECE LAID OUT FOR 1/4" HOLE 3. BLADE OF SQUARE EXTENDING OVER WORK PIECE 4. SCRIBE EDGE OF WORK PIECE ON OPPOSITE SIDE FROM 3/16" RADIUS 5. REMOVE RULE FROM SQUARE HEAD 6. LAY EDGE OF RULE ON 1 9/16" SCRIBED LINE AND AT TOP OF 3/16" RADIUS LINE 7. SCRIBE STRAIGHT LINE BETWEEN TWO POINTS 8. CHECK ALL LAYOUT LINES AND POINTS FOR ACCURACY

ROUTE WORK TO DRILL PRESS

SKETCH: DRAWING #2: DRILL DRIFT

REFERENCES: REF. #1, PP. 6-1 TO 6-10
REF. #2, PP. 62-66, 215-216

JOB SHEET
IN
DRILL PRESS

DP-2

JOB: MAKE DRILL DRIFT

MATERIALS: WORK PIECE 1/4" X 3/4" X 5" WITH PROPER LAYOUT

TOOLS AND EQUIPMENT: DRILL PRESS, DRILL PRESS VISE, DRILL CHUCK AND KEY, 1/4" STRAIGHT SHANK DRILL BIT, 82 DEGREE COUNTERSINK, PARALLELS

GENERAL INSTRUCTIONS: REVIEW REF. #1, PP. 34-1 TO 34-24 AND REF. #2, PP. 203-228.

PROCEDURES AND/OR TASKS:

DP-2-1	SET UP DRILL PRESS FOR TASK AND CHECK FOR PROPER RUNNING CONDITION. REFER TO CLAMP STRAP, JOB DP-1, TASK 1
DP-2-2	DRILL 1/4" HOLE, REFER TO CLAMP STRAP JOB DP-1, TASK 3
DP-2-3	COUNTERSINK 1/4" HOLE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. DRILL PRESS IN PROPER WORKING ORDER.
2. CORRECT SET UP FOR DRILLING 1/4" HOLE.
3. CORRECT SET UP FOR COUNTERSINKING.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MACHINES, MATERIAL, AND STANDARDS.

TASK SHEET

JOB: DP-2
TASK: 3
PAGE: 1

TASK:	COUNTERSINK 1/4" HOLE
JOB:	MAKE DRILL DRIFT
TRADE:	MACHINIST
TOOLS AND MATERIALS:	DRILL PRESS, 82 DEGREE COUNTERSINK, TOOL DRILL PRESS VISE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP DRILL PRESS	1. INSTALL COUNTERSINK TOOL SAME AS DRILL BIT
	2. SET DRILL PRESS SPEED AT APPROXIMATELY 80 RPM
	3. SET DEPTH STOP GAUGE AT 1/16"
2. COUNTERSINK	1. PUT ON GOGGLES OR SAFETY GLASSES
	2. PLACE WORK SECURELY IN DRILL PRESS VISE
	3. POSITION WORK PIECE UNDER COUNTERSINK TOOL
	4. LOWER COUNTERSINK TO HOLE FOR CENTERING
	5. RAISE COUNTERSINK TOOL
	6. TURN ON DRILL PRESS MOTOR
	7. HAND FEED COUNTERSINK SLOWLY INTO WORK PIECE HOLE TO STOP
	8. REMOVE WORK PIECE FROM VISE
	9. TURN WORK PIECE OVER AND REPEAT KEY POINTS 2 THROUGH 8
	10. CLEAN WORK STATION AND RETURN TOOLS TO STORAGE

ROUTE WORK PIECE TO BENCH

SKETCH: DRAWING #2, DRILL DRIFT

REFERENCES: REF. #1, P. 34-19
REF. #2, P. 224

B-2b

JOB SHEET
IN
BENCH WORK

JOB: MAKE DRILL DRIFT

MATERIALS: WORK PIECE 1/4" X 3/4" X 5", PROPERLY LAIDOUT, DRILLED, AND COUNTERSUNK

TOOLS AND EQUIPMENT: BENCH VISE, HAND HACKSAW, 24 TOOTH HACKSAW BLADE, SMOOTH MILL FILE WITH HANDLE, ABRASIVE CLOTH (120 GRIT), OIL

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, PP. 9-1 TO 9-5 AND REF. #2, PP. 84-89. CHECK WITH INSTRUCTOR AT FREQUENT INTERVALS.

PROCEDURES AND/OR TASKS:

B-2b-1	REMOVE EXCESS STOCK
B-2b-2	FILE TO SCRIBED LINE
B-2b-3	POLISH WORK PIECE, REFER TO CLAMP STRAP, JOB B-1b, TASK 4
B-2b-4	INSPECT WORK PIECE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. HOLD TO ALL SPECIFIED DIMENSIONS.
2. ALL FLAT SURFACES SQUARE AND PARALLEL.
3. RADII HELD EVEN AND TRUE.
4. FINISH SMOOTH.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MACHINES, WORK, AND STANDARDS.

TASK SHEET

JOB: B-2b
TASK: 1
PAGE: 1

TASK: REMOVE EXCESS STOCK WITH HAND HACKSAW

JOB: MAKE DRILL DRIFT

TRADE: MACHINIST

TOOLS AND MATERIALS: BENCH VISE, HAND HACKSAW, 24 TOOTH HACKSAW BLADE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. REMOVE EXCESS STOCK FROM RADIUS END	1. MOUNT WORK PIECE IN VISE a. PROTECT WORK PIECE b. RADIUS END UP 2. SAW OFF CORNERS OF WORK PIECE RADIUS END 3. STAY OUTSIDE RADIUS SCRIBED LINE 4. REMOVE WORK PIECE FROM VISE
2. REMOVE EXCESS STOCK FROM ANGLE (SEE OPTIONAL SHAPER OPERATION)	1. MOUNT WORK PIECE IN VISE a. PROTECT WORK PIECE b. SCRIBED LINE IN VERTICAL POSITION c. ANGLE END UP d. EXTEND END 2 1/2" ABOVE VISE JAWS 2. TIGHTEN VISE 3. START CUT AT ANGLE END 4. KEEP CUT OUTSIDE SCRIBED LINE 5. MAKE CUT ALMOST TO VISE 6. REPOSITION WORK PIECE IN VISE a. RAISE WORK PIECE UNTIL REMAINDER OF ANGLE LINE IS EXPOSED ABOVE VISE b. KEEP ANGLE LINE VERTICAL c. TIGHTEN VISE 7. COMPLETE SAW CUT 8. REMOVE WORK PIECE FROM VISE 9. CLEAN HACKSAW AND RETURN TO STORAGE

SKETCH: DRAWING #2: DRILL DRIFT

REFERENCES: REF. #1, PP. 9-1 TO 9-5
REF. #2, PP. 84-89

TASK SHEET

JOB: B-2b
TASK: 2
PAGE: 1

TASK: FILE TO SCRIBE LINES

JOB: MAKE DRILL DRIFT

TRADE: MACHINIST

TOOLS AND MATERIALS: BENCH VISE, 10" MILL FILE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK PIECE	1. TO FILE RADIUS
	2. OPEN VISE 1/2"
	3. MOUNT WORK PIECE VERTICAL IN VISE WITH RADIUS END 1" ABOVE VISE
	4. PROTECT WORK PIECE
	5. TIGHTEN VISE
2. FILE RADIUS	1. USE 10" MILL FILE WITH HANDLE
	2. KEEP FILE AT RIGHT ANGLE TO FLAT SIDE OF WORK PIECE AT ALL TIMES
	3. FILE RADIUS TO LAYOUT LINE
	4. REMOVE WORK PIECE FROM VISE
3. MOUNT WORK PIECE	1. TO FILE ANGLE
	2. MOUNT WORK PIECE IN VISE WITH ANGLE SIDE UP AND PARALLEL TO JAWS OF VISE
(SEE OPTIONAL SHAPER OPERATION)	3. WORK PIECE ANGLE SIDE IS TO BE 1/4" ABOVE TOP OF VISE JAWS
	4. PROTECT WORK
4. FILE ANGLE	1. FILE TO LAYOUT LINE
	2. USE SAME FILING PROCEDURE AS IN CLAMP STRAP JOB B-1a
	3. REMOVE WORK PIECE FROM VISE
5. MOUNT WORK PIECE	1. TO FILE 3/16" RADIUS
	2. MOUNT WORK PIECE IN VISE WITH ANGLE SURFACE PARALLEL TO VISE JAWS
	3. MOUNT ANGLE SURFACE 1/2" ABOVE JAWS

5. MOUNT WORK PIECE (CON'T.)	4. PROTECT WORK PIECE
6. FILE 3/16" RADIUS	1. FILE 3/16" RADIUS OVER EDGE 2. HOLD TO SCRIBE LINE 3. KEEP FILE AT RIGHT ANGLE TO FLAT SURFACE OF WORK PIECE 4. REMOVE WORK PIECE FROM VISE 5. CLEAN FILE AND RETURN TO STORAGE 6. CLEAN WORK STATION

SKETCH: DRAWING #2: DRILL DRIFT

REFERENCES: REF. #1, PP. 17-1 TO 17-7
REF. #2, PP. 113-117

TASK SHEET

JOB: B-2b
TASK: 4
PAGE: 1

TASK: INSPECT WORK PIECE

JOB: MAKE DRILL DRIFT

TRADE: MACHINIST

TOOLS AND MATERIALS: STEEL RULE, OUTSIDE CALIPERS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. OVERALL SIZE	1. LENGTH
	2. WIDTH
	3. THICKNESS
2. ANGLE	1. LENGTH
	2. STRAIGHT CUT
	3. FINISHED AT 90 DEGREE TO FLAT SURFACES
3. RADII	1. 3/8" RADIUS
	2. 3/16" RADIUS
	3. 1/8" RADIUS
4. HOLE	1. LOCATION
	2. SIZE
	3. COUNTERSINK
5. FINISH	POLISHED

SKETCHES: DRAWING #2: DRILL DRIFT

REFERENCES: REF. #1, PP. 5-1 TO 5-2

OPTIONAL S-1

JOB SHEET
IN
SHAPER

JOB: MAKE DRILL DRIFT

MATERIALS: WORK PIECE 1/4" X 3/4" X 5" FLAT COLD ROLLED STEEL READY FOR SHAPING TAPERED SIDE

TOOLS AND EQUIPMENT: SHAPER, SURFACE GAUGE, SHAPER TOOL HOLDER, SHAPER TOOL BIT, 10" SMOOTH MILL FILE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, "PLANING MACHINES", PP. 37-1 TO 37-16 AND "SURFACE GAUGE", PP. 6-3 TO 6-4, REF. #2, "SHAPER OPERATION", PP. 499-523.

PROCEDURES AND/OR TASKS:

S-1-1	CHECK THE SHAPER FOR PROPER RUNNING CONDITION
S-1-2	SET UP SHAPER
S-1-3	CUT WORK PIECE TO TAPER LAYOUT LINE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. MACHINE VISE INDICATES TRUE.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. SMOOTH MACHINE FINISH.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MACHINES, WORK, AND SPECIFICATIONS.

TASK SHEET

JOB: S-1
TASK: 1
PAGE: 1

TASK: CHECK SHAPER FOR PROPER RUNNING CONDITION

JOB: MAKE DRILL DRIFT

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, OIL CAN

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHECK OIL RESERVOIR	1. FILL TO PROPER RUNNING LEVEL 2. FLYWHEEL MUST RUN IN OIL
2. RAM WAY OILERS	1. FILL RAM WAY OILERS 2. PUT OIL IN ALL OIL CAPS ON MACHINE
3. GUARDS	1. ALL GUARDS SECURELY IN PLACE 2. TIGHTEN IF NECESSARY
4. MACHINE OPERATION	1. TURN ON SHAPER MOTOR 2. ENGAGE RAM 3. CHECK FOR PROPER OPERATION AND ADJUSTMENT

SKETCHES: DRAWING #2: DRILL DRIFT

REFERENCES: REF. #1, PLANING MACHINES, PP. 37-1 TO 37-16
REF. #2, SHAPER OPERATION, PP. 499-523

TASK SHEET

JOB: S-1
TASK: 2
PAGE: 1

TASK: SET UP SHAPER

JOB: MAKE DRILL DRIFT

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, SURFACE GAUGE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHECK VISE	1. VISE WELL BELOW RAM
	2. MOUNT DIAL INDICATOR ON RAM
	3. DISENGAGE RAM
	4. HAND FEED RAM TO INDICATE VISE TRUE
2. SET UP MACHINE	1. MOUNT TOOL HOLDER TO CLAPPER BOX
	2. MOUNT CUTTING TOOL IN THE TOOL HOLDER
	3. SET LENGTH OF STROKE 1/2" BEFORE TOOL STARTS CUT AND 3/4"-1/4" PAST CUT
	4. SET FEED OF STROKE PER CUT
	5. SET SPEED OF STROKE
3. MOUNT WORK IN VISE	1. OPEN VISE
	2. SET TAPERED LAYOUT LINE PARALLEL TO TOP OF VISE
	3. USE SURFACE GAUGE TO TRUE LAYOUT LINE PARALLEL TO TOP OF VISE
	4. TAP WORK INTO POSITION WITH HAMMER
	5. TIGHTEN VISE

SKETCHES: DRAWING #2: DRILL DRIFT

REFERENCES: REF. #1, PP. 6-3 TO 6-4
REF. #2, PP. 57-58

TASK SHEET

JOB: S-1
TASK: 3
PAGE: 1

TASK: CUT WORK PIECE TO TAPER LAYOUT LINE

JOB: MAKE DRILL DRIFT

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, 10" SMOOTH MILL FILE, STEEL RULE, OUTSIDE CALIPERS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. PREPARE MACHINE FOR CUTTING	1. HAND FEED RAM TO POSITION CUTTING TOOL OVER WORK 2. RAISE VISE TABLE UNTIL WORK IS 1/16" BELOW CUTTING TOOL 3. TOOL HEAD SHOULD BE ABOUT THE CENTER OF ITS MOVEMENT
2. CUT TO LAYOUT LINE	1. PUT ON GOGGLES 2. START MACHINE 3. HAND FEED WORK SLOWLY UNTIL TOOL BEGINS TO CUT 4. START AUTOMATIC FEED 5. CUT TO LAYOUT LINE
3. CLEAN MACHINE	1. REMOVE TOOL AND STORE 2. CLEAN CHIPS OFF MACHINE AND DISPOSE OF THEM 3. USE A BRUSH NOT AIR 4. WIPE MACHINE CLEAN WITH RAG
4. REMOVE BURRS	1. REMOVE WORK FROM MACHINE 2. MOUNT IN BENCH VISE 3. FILE BURRS WITH SMOOTH MILL FILE
5. INSPECT	1. ANGLE CUT TO SCRIBE LINE 2. LENGTH OF ANGLE CUT 3. ANGLE CUT SQUARE TO FLAT SURFACE 4. SMOOTH MACHINE FINISH NOTE: THE MACHINE FINISH MAY BE DESIRED IN PREFERENCE TO POLISHED SURFACE

ROUTE TO BENCH

SKETCHES: DRAWING #2: DRILL DRIFT

REFERENCES: REF. #1, PP. 5-1 TO 5-2 AND PP. 37-1 TO 37-16
REF. #2, PP. 499-523

MACHINE SHOP

U-CLAMP STRAP

POWER HACKSAW	3
BENCH WORK	3
DRILL PRESS	3

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND CONSTRUCT A U-CLAMP STRAP ACCORDING TO SPECIFICATIONS; USING THE VARIOUS MACHINES, TOOLS, AND EQUIPMENT CALLED FOR IN THE JOB.

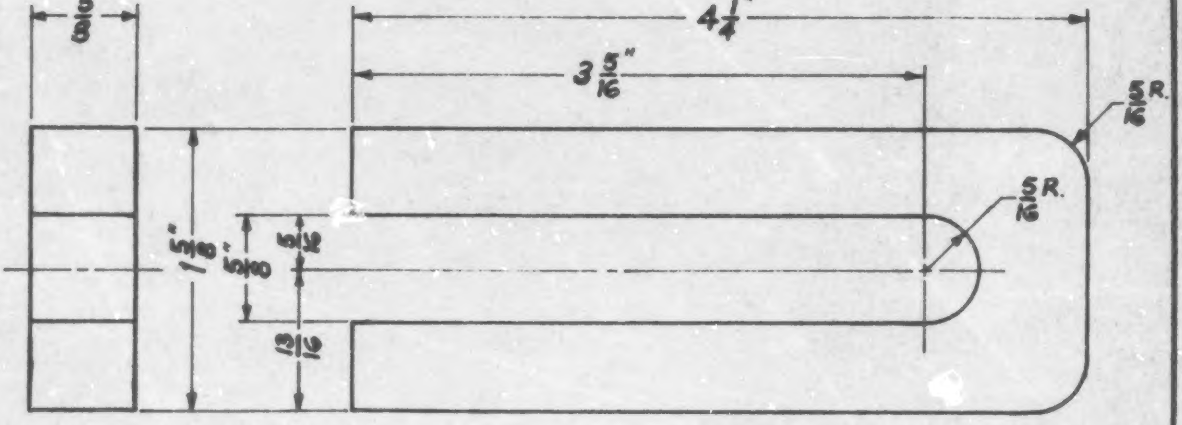
CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SETUP AND PREPARE MACHINES FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, AND MACHINES.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.


5/8"
4 1/4"
3 5/16"
5/16 R.
5/16 R.
1 5/8"
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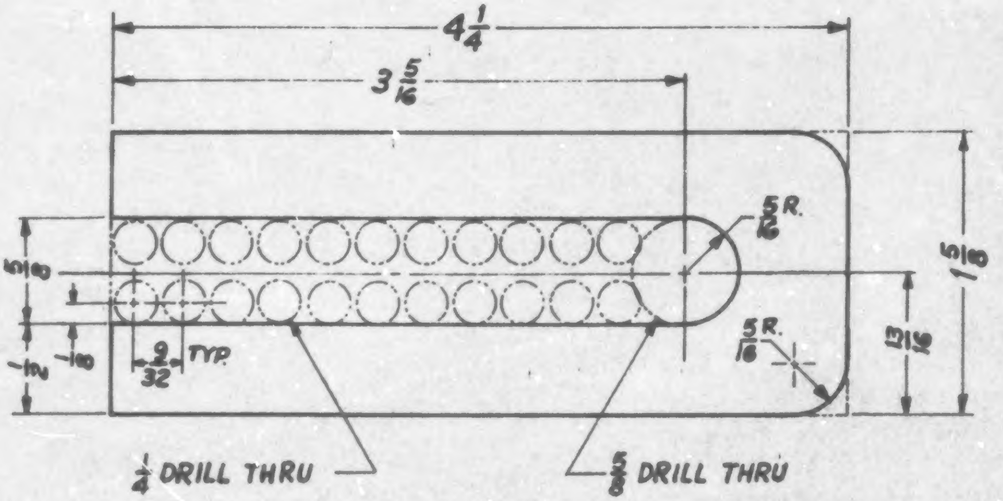
13/16

F.A.O.


4 1/4
3 5/16
5/16 R.
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1/2
9/32 TYP.
5/16 R.
1 5/8
13/16
1/4 DRILL THRU
5/8 DRILL THRU

LAYOUT DRAWING

DRAWING NO. 3	U-CLAMP STRAP	TOLERANCE CHART
BENCH JOB NO. 3 DRILL PRESS JOB NO. 2	MATERIAL: C.R.S. FINISH: FILE & POLISH SCALE: FULL SIZE	FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1/2°

PH-3

JOB SHEET
IN
POWER HACKSAW

JOB: MAKE U-CLAMP STRAP

MATERIALS: CUTTING OIL, COLD ROLLED FLAT STOCK STEEL, ONE PIECE 1 5/8" X 5/8" X 4 3/8"

TOOLS AND EQUIPMENT: POWER HACKSAW, 6" RULE, MILL FILE

GENERAL INSTRUCTIONS: REFER TO CLAMP STRAP, JOB PH-1. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

PH-3-1 SET UP POWER HACKSAW FOR TASK AND CHECK FOR PROPER RUNNING CONDITION, SEE TASK PH-1-1

PH-3-2 CUT CR FLAT STOCK TO LENGTH, SEE PH-1-2

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CORRECT MACHINE OPERATION AND SETUP.
2. SELECTION AND LAYOUT OF MATERIAL.
3. MATERIAL CUT AND FINISHED ACCORDING TO SPECIFICATIONS AND PRINT.

SKETCH: DRAWING #3: U-CLAMP STRAP

B-3a

JOB SHEET
IN
BENCH WORK

JOB: MAKE U-CLAMP STRAP

MATERIALS: CUTTING OIL, CHALK, COLD ROLLED FLAT STOCK STEEL, ONE PIECE 1 5/8" X 5/8" X 4 3/8"

TOOLS AND EQUIPMENT: BENCH VISE, SMOOTH MILL FILE, COMBINATION SQUARE, SCRIBE, HAMMER, CENTER PUNCH, DIVIDERS, FILE CARD, BRUSH

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REFER TO CLAMP STRAP, JOB B-1a. CHECK WITH INSTRUCTOR AT FREQUENT INTERVALS.

PROCEDURES AND/OR TASKS:

B-3a-1 SQUARE ENDS OF WORK PIECE. HOLD TO 4 1/4", REFER TO CLAMP STRAP, JOB B-1a, TASK 1

B-3a-2 LAYOUT WORK PIECE TO SPECIFICATIONS

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. HOLD TO ALL PRINT DIMENSIONS.
2. ALL FLAT SURFACES ARE SQUARE AND PARALLEL.
3. RADII HELD EVEN.
4. FINISH SMOOTH.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MACHINES, WORK, AND STANDARDS.

TASK SHEET

JOB: B-3a
TASK: 2
PAGE: 1

TASK: LAYOUT WORK PIECE TO SPECIFICATIONS

JOB: MAKE U-CLAMP STRAP

TRADE MACHINIST

TOOLS AND MATERIALS: LAYOUT FLUID, COMBINATION SQUARE, SCRIBE, DIVIDERS, HAMMER, CENTER PUNCH

TASK BREAKDOWN:

STEPS	KEY POINTS
1. INK LAYOUT	1. REMOVE ALL GREASE AND OIL FROM SURFACE OF WORK PIECE 2. COVER ENTIRE SURFACE OF ONE SIDE OF WORK PIECE WITH LAYCUT FLUID 3. ALLOW TO DRY
2. DETERMINE CENTER OF 5/16" CORNER RADIUS	1. SET COMBINATION SQUARE ON 5/16" 2. SET SQUARE HEAD AGAINST EDGE OF WORK PIECE 3. PLACE SCRIBE AGAINST END OF RULE 4. SCRIBE SHORT LINE ABOUT 1/4" LONG, SEE DRAWING 5. REPEAT STEPS 2, 3, AND 4 ON OPPOSITE SIDE FROM FIRST MARK, SAME END 6. SET SQUARE HEAD AGAINST END OF WORK 7. SCRIBE A SHORT LINE ACROSS EACH OF THE PREVIOUSLY SCRIBED LINES
3. CENTER PUNCH	1. REFER TO CLAMP STRAP, JOB B-1a, TASK 3 2. PUNCH BOTH LINE INTERSECTIONS
4. LAYOUT 5/16" RADII	1. SET DIVIDER ON 5/16" 2. PLACE ONE LEG OF DIVIDER IN ONE INDENTION MADE WITH CENTER PUNCH 3. SCRIBE ARC AROUND CORNER 4. REPEAT STEPS 2 AND 3 ON OPPOSITE CORNER

5. DETERMINE CENTER OF 5/8" HOLE	1. SET COMBINATION SQUARE ON 13/16" 2. POSITION SQUARE HEAD AGAINST SIDE OF WORK PIECE 3. SCRIBE LINE DOWN ENTIRE LENGTH OF WORK PIECE NOTE: THIS IS ALSO CENTER OF 1 5/8" WIDE WORK PIECE 4. SET COMBINATION SQUARE ON 15/16" 5. POSITION SQUARE HEAD AGAINST END LAID OUT FOR RADII 6. SCRIBE LINE ACROSS LINE SCRIBED IN STEP 3
6. DETERMINE CENTER OF FIRST TWO 1/4" HOLES	1. SET COMBINATION SQUARE ON 5/8" 2. POSITION THE SQUARE HEAD AGAINST EITHER EDGE OF WORK PIECE 3. POSITION THE SCRIBE AGAINST END OF RULE 4. SCRIBE LINE FROM 5/8" HOLE LOCATION TO OPPOSITE END OF PART 5. POSITION SQUARE HEAD AGAINST OPPOSITE EDGE AND REPEAT STEPS 3 AND 4 6. SET SQUARE HEAD ON 1/8" 7. POSITION SQUARE HEAD AGAINST END OF WORK OPPOSITE RADII 8. SCRIBE SHORT PERPENDICULAR LINES ACROSS THE TWO PARALLEL LINES
7. DETERMINE CENTER OF REMAINING 1/4" HOLES	1. SET COMBINATION SQUARE ON 13/32" AND REPEAT KEY POINT 8 OF STEP 6 2. SET COMBINATION SQUARE ON 11/16" AND MARK INTERSECTION 3. SET COMBINATION SQUARE ON 31/32" AND REPEAT STEP 2 4. CONTINUE WITH SAME PROCEDURE. RESET EACH TIME TO THE FOLLOWING READINGS: 1 1/4", 1 17/32", 1 13/16", 2 3/32", 2 3/8", 2 21/32", 2 15/16"
8. CENTER PUNCH HOLES	REPEAT STEP 3 TO MARK CENTERS OF ALL 23 HOLES
9. LAYOUT SIDES OF SLOT	1. SET COMBINATION SQUARE ON 1/2" 2. POSITION SQUARE HEAD ON EDGE OF

9. LAYOUT SIDES OF SLOT (CON'T.)	WORK PIECE 3. POSITION SCRIBE AT END OF RULE 4. SCRIBE LINE PARALLEL TO AND SAME LENGTH AS LINE INDICATING CENTER LINE OF SIDE HOLES NOTE: THIS WILL BE THE FINISH LINE FOR ONE SIDE OF SLOT 5. REPEAT ON OPPOSITE SIDE NOTE: THIS SLOT SHOULD NOW BE LAID OUT 5/8" WIDE

SKETCHES: DRAWING #3: U-CLAMP STRAP

REFERENCES: REF. #1, PP. 6-1 TO 6-10
REF. #2, PP. 62-66

DP-3

JOB SHEET
IN
DRILL PRESS

JOB: MAKE U-CLAMP STRAP

MATERIALS: WORK PIECE 1 5/8" X 5/8" X 4 1/4" WITH PROPER LAYOUT

TOOLS AND EQUIPMENT: DRILL PRESS, DRILL PRESS VISE, PARALLELS, DRILL CHUCK AND KEY, DRILL DRIFT, 1/4" STRAIGHT SHANK DRILL, 5/8" TAPER SHANK DRILL

GENERAL INSTRUCTIONS: REVIEW REF. #1, PP. 34-1 TO 34-24 AND REF. #2, PP. 203-228. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

DP-3-1 CHECK DRILL PRESS FOR OPERATION. REFER TO CLAMP STRAP JOB DP-1, TASK 1
DP-3-2 DRILL 1/4" HOLE IN WORK PIECE, REFER TO CLAMP STRAP JOB DP-1, TASK 3
DP-3-3 DRILL SINGLE 5/8" HOLE IN WORK PIECE, REFER TO CLAMP STRAP JOB DP-1, TASK 4

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. DRILL PRESS IN PROPER WORKING ORDER.
2. CORRECT SETUP FOR DRILLING 1/4" HOLE.
3. CORRECT SETUP FOR 5/8" HOLE.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

B-3b

JOB SHEET
IN
BENCH WORK

JOB: MAKE U-CLAMP STRAP

MATERIALS: ONE PIECE 1 5/8" X 5/8" X 4 1/4" COLD ROLLED STEEL

TOOLS AND EQUIPMENT: BENCH PLATE, BENCH VISE, HAMMER, FLAT COLD CHISEL, 10" MILL FILE, OUTSIDE CALIPER, ABRASIVE CLOTH (120 GRIT)

GENERAL INSTRUCTIONS: REVIEW JOBS B-1b AND B-2b. READ REFERENCES #1, PP. 17-1 TO 17-7, #2 PP. 113-117. CHECK WITH INSTRUCTOR AT FREQUENT INTERVALS. PRACTICE SAFE WORKING HABITS.

PROCEDURES AND/OR TASKS:

B-3b-1	REMOVE EXCESS STOCK FROM SLOT WITH HAND HACKSAW
B-3b-2	SHEAR EXCESS MATERIAL IN SLOT WITH COLD CHISEL
B-3b-3	FILE SLOT TO LAYOUT LINES
B-3b-4	FILE RADII TO LAYOUT LINES
B-3b-5	DRAWFILE ALL EDGES
B-3b-6	POLISH, REFER TO CLAMP STRAP, JOB B-1b, TASK 4
B-3b-7	INSPECT

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. HOLD TO ALL PRINT DIMENSIONS.
2. ALL FLAT SURFACES ARE SQUARE AND PARALLEL.
3. RADII HELD EVEN.
4. FINISH MEETS STANDARDS REQUIRED (SMOOTH).
5. CORRECT SETUP.
6. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: B-3b
TASK: 1
PAGE: 1

TASK: REMOVE EXCESS STOCK FROM SLOT WITH HAND HACKSAW

JOB: MAKE U-CLAMP STRAP

TRADE: MACHINIST

TOOLS AND MATERIALS: BENCH VISE, HAND HACKSAW (18 TOOTH BLADE)

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK	1. OPEN BENCH VISE 1" 2. PROTECT WORK 3. PLACE WORK IN VISE WITH SLOT EXPOSED 4. BOTTOM OF SLOT SLIGHTLY ABOVE VISE JAWS 5. TIGHTEN VISE
2. SELECT HAND HACKSAW	1. BLADE IN GOOD CONDITION 2. BLADE WITH 18 TEETH PER INCH 3. PROPER TENSION ON BLADE
3. REMOVE EXCESS STOCK	1. SAW DOWN EACH SIDE OF SLOT 2. SAW ON OUTSIDE OF LAYOUT LINES NOTE: BE CAREFUL NOT TO SCAR SIDES OF 5/8" HOLE 3. REMOVE WORK 4. CLEAN HACKSAW AND RETURN TO PROPER PLACE

SKETCHES: DRAWING #3: U-CLAMP STRAP

REFERENCES: REF. #1, PP. 8-1 TO 8-3
REF. #2, PP. 101-105

TASK SHEET

JOB: B-3b
TASK: 2
PAGE: 1

TASK: SHEAR EXCESS MATERIAL IN SLOT WITH COLD CHISEL

JOB: MAKE U-CLAMP STRAP

TRADE: MACHINIST

TOOLS AND MATERIALS: BENCH VISE, COLD CHISEL, HAMMER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK	1. OPEN BENCH VISE 1" 2. INSERT WORK PIECE IN VISE a. SLOT OPEN TO LEFT b. BOTTOM LAYOUT LINE PARALLEL AND EVEN WITH VISE JAWS 3. PROTECT WORK 4. TIGHTEN VISE
2. SELECT COLD CHISEL	1. CUTTING ANGLE OF 60 DEGREES 2. CORNERS SLIGHTLY ROUNDED 3. CUTTING EDGE SHARP 4. THE HEAD TAPERED AND A LITTLE ROUNDED
3. SHEAR EXCESS STOCK	1. PUT ON SAFETY GOGGLES 2. HOLD CHISEL LOOSELY WITH HEAD ABOUT 1" ABOVE HAND 3. GRASP HAMMER HANDLE NEAR END WITH OTHER HAND NOTE: HOLD LOOSELY TO KEEP FROM TIRING 4. HOLD CHISEL IN POSITION TO MAKE PROPER SIZE CHIP 5. STRIKE CHISEL SQUARELY ON HEAD WITH SHARP BLOW 6. RESET CHISEL AFTER EACH BLOW 7. HOLD TO LAYOUT LINE 8. REPEAT STEPS 1-3 ON OPPOSITE SIDE OF SLOT 9. RETURN TOOLS TO PROPER PLACE 10. CLEAN WORK AREA

SKETCHES: DRAWING #3: U-CLAMP STRAP

REFERENCES: REF. #1, PP. 8-1 TO 8-3
REF. #2, PP. 101-105

TASK SHEET

JOB: B-3b
TASK: 3
PAGE: 1

TASK: FILE SLOT TO LAYOUT LINES

JOB: MAKE U-CLAMP STRAP

TRADE: MACHINIST

TOOLS AND MATERIALS: BENCH VISE, 10" MILL FILE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK	1. OPEN BENCH VISE 1" 2. PLACE WORK IN VISE a. PARALLEL TO BENCH b. SLOT EXPOSED c. BOTTOM FINISH LINE SLIGHTLY ABOVE VISE JAWS 3. PROTECT WORK 4. TIGHTEN VISE
2. DRAWFILE BOTTOM OF SLOT	1. USE 10" MILL FILE WITH HANDLE 2. FACE OPEN END OF SLOT 3. PLACE ONE HAND ON HANDLE AND OTHER HAND ON END OF FILE 4. THUMBS ABOUT 1/2" TO 3/4" FROM WORK ON EACH SIDE 5. DRAW FILE BACK AND FORTH OVER BOTTOM SIDE OF SLOT 6. PRESS ONLY ON FORWARD STROKE 7. KEEP FILE AT RIGHT ANGLE TO FLAT SURFACE 8. CONTINUE TO DRAWFILE TO FINISH LINE NOTE: BE CAREFUL NOT TO SCAR 5/16" RADIUS 9. REMOVE WORK
3. FILE TOP SIDE OF SLOT	1. TURN WORK OVER 2. REPEAT STEPS 1 AND 2

SKETCHES: DRAWING #3: U-CLAMP STRAP

REFERENCES: REF. #1, PP. 17-1 TO 17-7
REF. #2, PP. 113-117

TASK SHEET

JOB: B-3b
TASK: 4
PAGE: 1

TASK: FILE CORNER RADII TO LAYOUT LINES

JOB: MAKE U-CLAMP STRAP

TRADE: MACHINIST

TOOLS AND MATERIALS: BENCH VISE, 10" MILL FILE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK	1. OPEN BENCH VISE 1"
	2. PLACE WORK IN VISE a. PERPENDICULAR WITH BENCH b. SOLID END EXPOSED
	3. PROTECT WORK
	4. TIGHTEN VISE
2. FILE FIRST CORNER	1. HOLD FILE SQUARE WITH FLAT SURFACES
	2. HOLD TO LAYOUT LINES
3. FILE REMAINING CORNER	1. REPEAT STEP 2
	2. REMOVE WORK

SKETCHES: DRAWING #3: U-CLAMP STRAP

REFERENCES: REF. #1, PP. 17-1 TO 17-7
REF. #2, PP. 113-117

TASK SHEET

JOB: B-3b
TASK: 5
PAGE: 1

TASK: DRAWFILE ALL EDGES

JOB: MAKE U-CLAMP STRAP

TRADE: MACHINIST

TOOLS AND MATERIALS: BENCH VISE, 10" MILL FILE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK	1. OPEN BENCH VISE 1"
	2. MOUNT ANY EDGE 1/2" ABOVE VISE JAWS
	3. PROTECT WORK
	4. TIGHTEN VISE
2. FILE	1. USE PROPER DRAWFILE METHOD, REFER TO TASK 3, STEP 2
	2. DRAWFILE BOTH EDGES TO MINIMUM CLEAN UP
	3. REPEAT ON OTHER SIDE OF WORK
	4. REMOVE WORK
	5. CLEAN FILE AND RETURN TO PROPER PLACE
	6. CLEAN UP WORK AREA

SKETCHES: DRAWING #3: U-CLAMP STRAP

REFERENCES: REF. #1, PP. 17-1 TO 17-7
REF. #2, PP. 113-117

TASK SHEET

JOB: B-3b
TASK: 6
PAGE: 1

TASK: INSPECT

JOB: MAKE U-CLAMP STRAP

TRADE: MACHINIST

TOOLS AND MATERIALS: INSIDE CALIPERS, OUTSIDE CALIPERS, MICROMETER, VERNIER CALIPER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. STOCK SIZE	1. WIDTH (1 5/8") 2. LENGTH (4 1/4") 3. THICKNESS (5/8") NOTE: CARE MUST BE TAKEN WHEN FILING AND POLISHING NOT TO REMOVE METAL BEYOND TOLERANCES
2. SLOT	1. WIDTH (5/8") a. INSIDE CALIPERS b. MICROMETER c. VERNIER CALIPER 2. LENGTH (3 5/8') a. OUTSIDE CALIPERS b. MICROMETER NOTE: SHOULD BE 5/8" FROM SOLID END
3. RADII	1. TWO OUTSIDE CORNERS 2. USE 5/16" RADIUS GAUGE
4. FINISH	POLISHED

SKETCHES: DRAWING #3: U-CLAMP STRAP

REFERENCES: REF. #1, PP. 4-1 TO 5-2

MACHINE SHOP T-NUT

POWER HACKSAW	4
BENCH WORK	4
DRILL PRESS	4
SHAPER	2
MILLING MACHINE	1

AIM: THE STUDENT WILL BE ABLE TO READ DRAWINGS, SELECT MATERIALS, AND CONSTRUCT A T-NUT ACCORDING TO SPECIFICATIONS; USING THE VARIOUS MACHINES, TOOLS, AND EQUIPMENT CALLED FOR IN THE JOB.

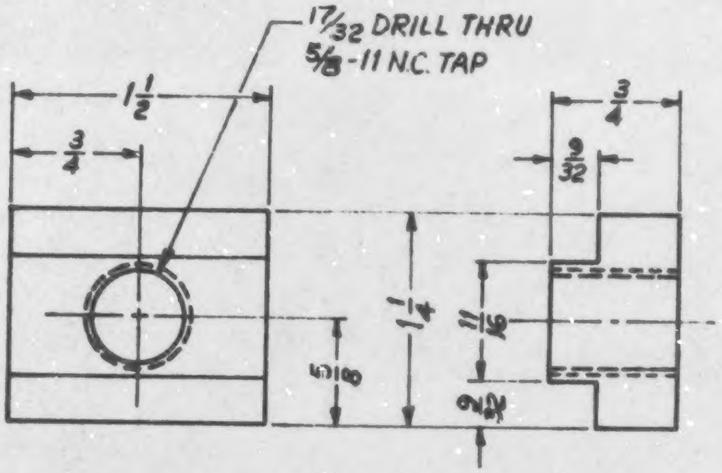
CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, AND MACHINES.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.


17/32 DRILL THRU
5/8-11 N.C. TAP
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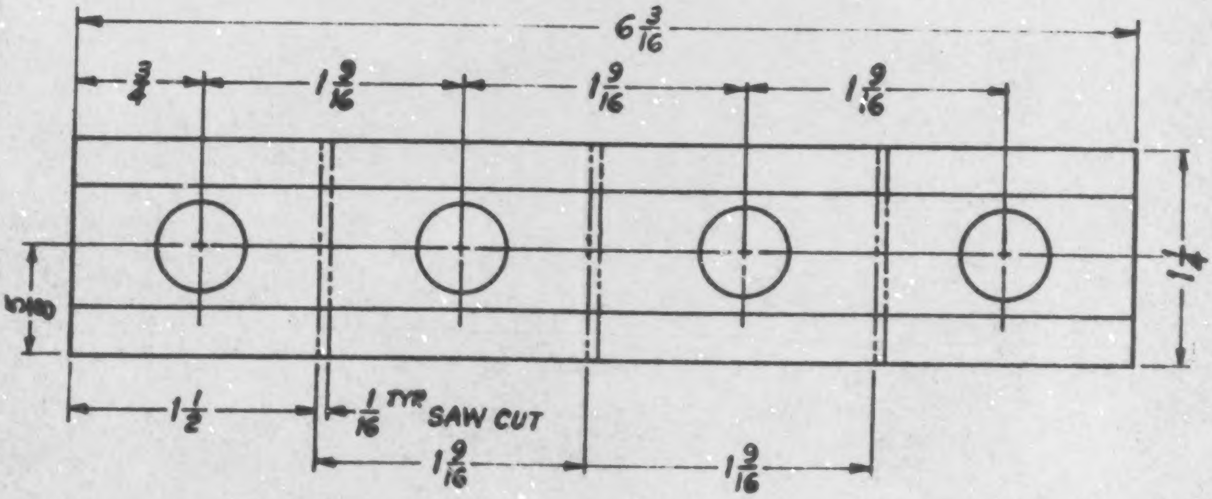
6 3/16
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1 9/16
1 9/16

LAYOUT DRAWING

DRAWING NO. 4	T-NUT	TOLERANCE CHART
BENCH JOB NO. 4 SHAPER JOB NO. 2 MILLING JOB NO. 1	MAT'L: C.R.S. FINISH: FILE & POLISH SCALE: FULL SIZE	FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1/2°

PH-4

JOB SHEET
IN
POWER HACKSAW

JOB: MAKE T-NUT

MATERIALS: CUTTING OIL, COLD ROLLED FLAT STOCK STEEL, ONE PIECE 3/4" X 1 1/4" X 6 1/2"

TOOLS AND EQUIPMENT: POWER HACKSAW, 6" RULE, MILL FILE

GENERAL INSTRUCTIONS: REFER TO CLAMP STRAP, JOB PH-1. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

PH-4-1 CHECK POWER HACKSAW FOR PROPER RUNNING CONDITION AND SETUP. SEE JOB PH-1, TASK 1

PH-4-2 SAW CR FLAT STOCK TO LENGTH. SEE JOB PH-1, TASK 2

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CUT AT 6 5/16" LENGTH.
2. CORRECT SETUP.
3. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

JOB SHEET
IN
BENCH WORK

JOB:	MAKE T-NUT	
MATERIALS:	WORK PIECE 3/4" X 1 1/4" X 6 3/16" COLD ROLLED STEEL	
TOOLS AND EQUIPMENT:	BENCH VISE, SMOOTH MILL FILE, COMBINATION SQUARE, SCRIBE, HAMMER, CENTER PUNCH, DIVIDERS	
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB REFER TO CLAMP STRAP, JOB B-1a. CHECK WITH INSTRUCTOR AT FREQUENT INTERVALS.	
PROCEDURES AND/OR TASKS:	B-4a-1	SQUARE BOTH ENDS OF MATERIAL AND HOLD TO 6 3/16". REFER TO CLAMP STRAP, JOB B-1, TASK 1
	B-4a-2	LAYOUT TO SPECIFICATIONS
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK. 1. HOLD TO ALL PRINT DIMENSIONS. 2. ALL FLAT SURFACES ARE SQUARE AND PARALLEL. 3. FINISH SMOOTH. 4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.	

TASK SHEET

JOB: B-4a
TASK: 2
PAGE: 1

TASK: LAYOUT TO SPECIFICATIONS
JOB: MAKE T-NUT
TRADE: MACHINIST
TOOLS AND MATERIALS: COMBINATION SQUARE, SCRIBE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LAYOUT CENTER LINE	1. SET COMBINATION SQUARE ON 5/8" 2. POSITION SQUARE HEAD ON EDGE OF WORK 3. POSITION SCRIBE AT END OF RULE 4. SCRIBE LINE DOWN ENTIRE LENGTH OF PART
2. DETERMINE CENTER OF HOLES	1. SET COMBINATION SQUARE ON 3/4" 2. POSITION THE SQUARE HEAD AGAINST EITHER END OF WORK 3. SCRIBE SHORT LINE ACROSS CENTER LINE 4. SET COMBINATION SQUARE ON 2 5/16" 5. SCRIBE SHORT LINE ACROSS CENTER LINE 6. SET COMBINATION SQUARE ON 3 7/8" 7. SCRIBE SHORT LINE ACROSS CENTER LINE 8. SET COMBINATION SQUARE ON 5 7/16" 9. SCRIBE SHORT LINE ACROSS CENTER LINE
3. CENTER PUNCH	1. REFER TO CLAMP STRAP JOB B-1a, TASK 3 2. PUNCH EACH OF THE FOUR INTERSECTIONS
4. LAYOUT SIDE STEPS	1. SET COMBINATION SQUARE ON 9/32" 2. POSITION SQUARE HEAD ON SIDE EDGE OF WORK 3. POSITION SCRIBE AT END OF RULE 4. SCRIBE LINE DOWN ENTIRE LENGTH OF

4. LAYOUT SIDE STEPS (CON'T.)	MATERIAL 5. REPEAT KEY POINTS 2, 3, AND 4 ON OTHER SIDE OF FACE 6. POSITION SQUARE HEAD FLAT ON THE LAID OUT FACE WITH RULE ON EDGE 7. SCRIBE LINE DOWN ENTIRE LENGTH OF MATERIAL EDGE 8. REPEAT KEY POINTS 6 AND 7 ON OPPOSITE EDGE
5. LAYOUT FOR PARTING	1. SET COMBINATION SQUARE ON 1 17/32" (1 1/2" PLUS 1/2 WIDTH OF 1/16" ALLOWED FOR PARTING EACH PIECE) NOTE: SCRIBE LINE WILL BE IN CENTER OF EACH CUT 2. POSITION COMBINATION SQUARE HEAD ON EITHER END OF WORK WITH RULE FLAT ON LAID OUT FACE 3. SCRIBE LINE ACROSS TOP 4. RESET THE COMBINATION SQUARE ON 3 3/32" 5. REPEAT KEY POINT 3 FROM SAME END 6. SET COMBINATION SQUARE ON 4 21/32" 7. REPEAT KEY POINT 3 FROM SAME END

ROUTE TO DRILL PRESS

SKETCHES: DRAWING #4: T-NUT

REFERENCES: REF. #1, PP. 6-1 TO 6-10
REF. #2, PP. 62-66

JOB SHEET
IN
DRILL PRESS

JOB: MAKE T-NUT

MATERIALS: WORK PIECE 3/4" X 1 1/4" X 6 3/16" COLD ROLLED STEEL, PROPERLY LAID OUT AND CENTERPUNCHED

TOOLS AND EQUIPMENT: DRILL PRESS, DRILL PRESS VISE, DRILL CHUCK AND KEY, 17/32" TAPER SHANK DRILL, 5/8"-11 N. C. TAP, PARALLELS

GENERAL INSTRUCTIONS: REVIEW REF. #1, PP. 34-1 TO 34-24, AND REF. #2, PP. 203-228. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

DP-4-1	CHECK DRILL PRESS FOR OPERATION. REFER TO CLAMP STRAP JOB DP-1, TASK 1
DP-4-2	DRILL FOUR 17/32" HOLES
DP-4-3	START 5/8"-11 N. C. TAP IN DRILL PRESS

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. DRILL PRESS IN PROPER WORKING ORDER.
2. CORRECT SETUP FOR DRILLING HOLES.
3. CORRECT SETUP FOR STARTING TAP.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: DP-4
TASK: 2
PAGE: 1

TASK:	DRILL FOUR 17/32" HOLES
JOB:	MAKE T-NUT
TRADE:	MACHINIST
TOOLS AND MATERIALS:	17/32" TAPER SHANK DRILL, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. INSTALL 17/32" TAPER SHANK DRILL	REFER TO CLAMP STRAP JOB DP-1, TASK 4, STEP 2 NOTE: 1/4" PILOT HOLE MAY BE DRILLED FIRST IF DESIRED
2. SET SPEED	APPROXIMATELY 300 RPM
3. MOUNT WORK	REFER TO CLAMP STRAP JOB DP-1, TASK 3, STEP 4
4. DRILL	REFER TO CLAMP STRAP JOB DP-1, TASK 3, STEP 5

SKETCHES: DRAWING #4 T-NUT

REFERENCES: REF. #1, PP. 34-1 TO 34-24
REF. #2, PP. 215-219

TASK SHEET

JOB: DP-4
TASK: 3
PAGE: 1

TASK: START 5/8"-11 N. C. TAP IN DRILL PRESS

JOB: MAKE T-NUT

TRADE: MACHINIST

TOOLS AND MATERIALS: DRILL CHUCK AND KEY, 5/8"-11 N. C. TAPER TAP, WORK PIECE, CUTTING OIL

TASK BREAKDOWN:

STEPS	KEY POINTS
1. INSTALL 5/8"-11 N. C. TAP	1. INSTALL DRILL CHUCKS IF NECESSARY 2. INSERT SHANK OF TAP 1" INTO CHUCK 3. TIGHTEN CHUCK WITH CHUCK KEY NOTE: USE CHUCK KEY IN ALL THREE HOLES FOR EVEN GRIP ON TAP 4. REMOVE CHUCK KEY
2. START TAP	1. HAND FEED TAP INTO HOLE OF WORK PIECE NOTE: MACHINE MUST NOT BE TURNED ON 2. TURN TAP BY TURNING BELTS OR PULLEYS 3. USE CUTTING OIL ON TAP 4. CONTINUE TO FEED TAP INTO HOLE UNTIL IT BEGINS TO GET TIGHT 5. REMOVE TAP BY TURNING PULLEY IN OPPOSITE DIRECTION 6. REPEAT THE PROCEDURE ON THE OTHER THREE HOLES NOTE: TWO PERSONS MAY BE REQUIRED TO DO THIS TASK
3. CLEAN UP	1. REMOVE TAP, CLEAN AND RETURN TO PROPER PLACE 2. WIPE MACHINE CLEAN 3. DISPOSE OF WASTE MATERIAL IN PROPER PLACE

ROUTE TO BENCH

SKETCHES: DRAWING #4: T-NUT

REFERENCES: REF. #1, PP. 11-1 TO 11-8
REF. #2, PP. 244-249

B-4b

JOB SHEET
IN
BENCH WORK

JOB: MAKE T-NUT

MATERIALS: WORK PIECE 3/4" X 1 1/4" X 6 3/16" COLD ROLLED STEEL PROPERLY LAID OUT AND DRILLED

TOOLS AND EQUIPMENT: BENCH VISE, 5/8"-11 N. C. TAPER TAP, T-HANDLE, TAP WRENCH, CUTTING OIL, STEEL SQUARE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, "HAND THREADING", PP. 11-1 TO 11-8, AND REF. #2, "TAPS AND TAPPING", PP. 244-249. CHECK WITH INSTRUCTOR AT FREQUENT INTERVALS.

PROCEDURES AND/OR TASKS: B-4b-1 HAND TAP FOUR 5/8" HOLES

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. USE CORRECT TAP AND WRENCH.
2. TAP STARTED SQUARE
3. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: B-4b
TASK: 1
PAGE: 1

TASK: HAND TAP FOUR 5/8" HOLES

JOB: MAKE T-NUT

TRADE: MACHINIST

TOOLS AND MATERIALS: BENCH VISE, T-HANDLE TAP WRENCH, CUTTING OIL, WORK PIECE, 5/8"-11 N. C. TAPER TAP

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK	1. OPEN BENCH VISE 1 1/2" 2. MOUNT WORK WITH STARTED THREADS UP 3. MOUNT WORK PARALLEL TO TABLE 4. PROTECT WORK 5. TIGHTEN VISE
2. PREPARE TAP	1. SELECT T-HANDLE TAP WRENCH 2. USE SAME TAP USED IN DRILL PRESS 3. PLACE SQUARE PORTION OF THE TAP SHANK IN ADJUSTABLE JAWS OF T-HANDLE TAP WRENCH
3. HAND TAP FIRST HOLE	1. GRASP TAP WRENCH DIRECTLY OVER THE TAP FROM TOP SIDE 2. PLACE TAP IN HOLE 3. PRESS DOWN AND TURN T-HANDLE CLOCK-WISE 4. USE PLENTY OF CUTTING OIL NOTE: KEEP TAP SQUARE WITH WORK 5. WHEN TAP GETS TIGHT UNSCREW TAP 1/2 TURN TO BREAK CHIPS LOOSE 6. CONTINUE TO SCREW TAP DEEPER INTO HOLE 7. REPEAT UNTIL THREADS ARE EXTENDING THROUGH HOLE
4. TAP REMAINING THREE HOLES	REPEAT STEP 3
5. CLEAN UP	1. REMOVE TAP FROM T-HANDLE 2. CLEAN TAP AND HANDLE 3. RETURN TOOLS TO PROPER PLACE

5. CLEAN UP (CON'T.) 4. CLEAN WORK AREA

ROUTE WORK TO SHAPER OR MILLING MACHINE

SKETCHES: DRAWING #4: T-NUT

REFERENCES: REF. #1, PP. 11-1 TO 11-8
REF. #2, PP. 244-249

S-2

JOB SHEET
IN
SHAPER

JOB: MAKE T-NUT

MATERIALS: WORK PIECE 3/4" X 1 1/4" X 6 3/16" FLAT COLD ROLLED STEEL LAID OUT, DRILLED, AND TAPERED

TOOLS AND EQUIPMENT: SHAPER, SHAPER TOOL HOLDER, SHAPER TOOL BIT, ABRASIVE CLOTH, POWER HACKSAW, 10" MILL FILE, PARALLEL BARS, OIL CAN, 0-1" MICROMETER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, "PLANING MACHINES", PP. 37-1 TO 37-16 AND REF. #2, "THE SHAPER AND SHAPER OPERATIONS", PP. 499-523. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

S-2-1	CHECK SHAPER FOR PROPER RUNNING CONDITION. REFER TO DRILL DRIFT, JOB S-1, TASK 1
S-2-2	SET UP SHAPER
S-2-3	SHAPE T-NUT TO DRAWING SPECIFICATIONS

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. PROPER MACHINE SETUP.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. SMOOTH MACHINE FINISH.
4. ALL SURFACES SQUARE AND PARALLEL TO EACH OTHER.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: S-2
TASK: 2
PAGE: 1

TASK: SET UP SHAPER

JOB: MAKE T-NUT

TRADE: MACHINIST

TOOLS AND MATERIALS: PARALLELS, SURFACE GAUGE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK IN VISE	1. REFER TO DRILL DRIFT JOB S-1, TASK 2, STEP 3 2. OPEN VISE 6 1/2" 3. SET PARALLEL BARS UNDER WORK 4. MOUNT WORK WITH LAYOUT UP 5. TOP OF WORK 3/8" ABOVE VISE 6. POSITION WORK PARALLEL TO STROKE OF MACHINE 7. TIGHTEN VISE NOTE: LEAVE ENDS OF WORK UNPROTECTED
2. PREPARE CUTTING TOOL	1. SELECT SHARP ROUGHING TOOL NOTE: TOOL MUST CUT THE SQUARE SHOULDER 2. PLACE TOOL IN HOLDER WITH 1/2" EXPOSED 3. TIGHTEN TOOL IN HOLDER USING PROPER WRENCH
3. INSTALL TOOL HOLDER	1. IN CLAPPER BOX 2. TIGHTEN TOOL HOLDER 3. SET AT MIDDLE OF ADJUSTMENT
4. SET RAM	1. RAISE VISE UNTIL TOOL IS 1/16" ABOVE WORK 2. ADJUST RAM STROKE UNTIL TOOL IS 3/4" BEYOND WORK 3. ADJUST RETURN STROKE UNTIL TOOL IS 1/2" BEYOND END OF WORK
5. SET FEED	SET PROPER AMOUNT OF FEED

5. SET FEED (CON'T.)	NOTE: THE HAND FEEDING IS RECOMMENDED
6. SET RAM SPEED	REFER TO REF. #1, PP. 37-7

SKETCHES: DRAWING #4: T-NUT

REFERENCES: REF. #1, PP. 37-3 TO 37-8

TASK SHEET

JOB: S-2
TASK: 3
PAGE: 1

TASK: SHAPE T-NUT TO DRAWING SPECIFICATIONS

JOB: MAKE T-NUT

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, SHAPER TOOL HOLDER, SHAPER TOOL BIT, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. ROUGH SHAPE WORK ON FIRST SIDE	1. PUT ON GOGGLES NOTE: EVERYONE NEAR SHOULD WEAR GOGGLES, CHIPS CAN FLY SEVERAL FEET 2. START MACHINE 3. RAISE TABLE WITH HAND CRANK 4. FEED WORK INTO TOOL SLOWLY 5. CUT ACROSS TOP TO WITHIN 1/16" OF LAYOUT LINE 6. HAND FEED TABLE BACK TO STARTING POSITION (TOOL OFF WORK) 7. RAISE TABLE 1/32" 8. REPEAT STEPS 3-7 UNTIL NOTCH HAS BEEN ROUGHED OUT 9. STOP MACHINE
2. CHANGE TOOL	1. REMOVE CUTTING TOOL 2. SELECT PROPER FINISHING TOOL NOTE: SHARPEN TOOL IF NECESSARY 3. MOUNT TOOL IN TOOL HOLDER 4. TIGHTEN TOOL
3. FINISH SHAPE WORK FIRST NOTCH	1. POSITION CUTTING TOOL a. BOTTOM OF ROUGHED OUT NOTCH b. SLIGHTLY ABOVE WORK 2. START MACHINE 3. FEED TOOL DOWN BY USE OF SWIVEL HEAD HANDLE 4. FEED TOOL OVER WORK WITH TABLE CRANK 5. CUT TO BOTTOM AND SIDE LAYOUT LINES

3. FINISH SHAPE WORK FIRST NOTCH (CON'T.)	6. STOP MACHINE 7. MOVE TABLE OVER UNTIL TOOL IS OFF WORK AT STARTING POINT 8. RAISE SWIVEL HEAD 9. POSITION TOOL UNTIL CUTTING EDGE IS ON TOP LAYOUT LINE 10. START MACHINE 11. HAND FEED TOOL DOWN .005" PER STROKE 12. CUT TO LAID OUT CORNER NOTE: SIDE CUT SHOULD BLEND WITH BOTTOM CUT 13. STOP MACHINE
4. ROUGH SHAPE WORK ON SECOND SIDE	REPEAT STEP 1
5. FINISH SHAPE WORK ON SECOND SIDE	REPEAT STEPS 2 AND 3
6. REMOVE WORK FROM VISE	1. LOOSEN VISE 2. REMOVE WORK
7. CLEAN WORK STATION	1. CLEAN CHIPS OFF MACHINE AND DISPOSE OF THEM NOTE: USE BRUSH, CHIPS ARE SHARP AND WILL CUT HANDS 2. WIPE MACHINE CLEAN WITH RAG 3. SWEEP UP CHIPS AND DEPOSIT IN WASTE CONTAINER

ROUTE TO BENCH

SKETCHES: DRAWING #4: T-NUT

REFERENCES: REF. #1, PP. 37-1 TO 37-16
REF. #2, PP. 499-523

JOB SHEET
IN
MILLING MACHINE

JOB: MAKE T-NUT

MATERIALS: WORK PIECE 3/4" X 1 1/4" X 6 3/16" FLAT COLD ROLLED STEEL, TWO 5" X 3/4" X 1" MILLING CUTTERS, ONE 11/16" SPACING COLLAR

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, PP. 38-1 TO 38-37, AND REF. #2, PP. 524-564. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

M-1-1	CHECK MACHINE FOR OPERATION
M-1-2	SET UP HORIZONTAL MILL
M-1-3	MOUNT WORK PIECE IN VISE
M-1-4	MILL WORK PIECE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. PROPER MACHINE SETUP.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. SMOOTH MACHINE FINISH.
4. ALL SURFACES SQUARE AND PARALLEL ONE TO THE OTHER.
5. SAFE CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, MACHINES, WORK, AND STANDARDS.

TASK SHEET

JOB: M-1
TASK: 1
PAGE: 1

TASK: CHECK MACHINE FOR OPERATION

JOB: MAKE T-NUT

TRADE: MACHINIST

TOOLS AND MATERIALS: MILLING MACHINE, OIL

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOTOR	1. PROPER GROUNDING
	2. ON AND OFF SWITCH FUNCTION PROPERLY
2. LUBRICATION	1. OIL RESERVE OR COOLANT TANK AT RUNNING LEVEL
	2. PLACE ONE OR TWO DROPS IN EACH OIL HOLE
	3. CHECK WAYS FOR PROPER OILING NOTE: USE OIL CAN IF NECESSARY
3. BELTS	1. IN WORKING CONDITION
	2. PROPER TENSION
4. GUARDS	1. IN PLACE
	2. TIGHTEN IF NECESSARY

SKETCHES: DRAWING #4: T-NUT

REFERENCES: REF. #1, PP. 38-1 TO 38-37
REF. #2, PP. 524-564

TASK SHEET

JOB: M-1
TASK: 2
PAGE: 1

TASK: SET UP HORIZONTAL MILL

JOB: MAKE T-NUT

TRADE: MACHINIST

TOOLS AND MATERIALS: MILLING MACHINE, ONE 11/16" SPACING COLLAR, WORK PIECE, TWO 5" X 3/4" X 1" SIDE MILLING CUTTERS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP MILL ARBOR	1. WIPE FEMALE TAPER IN MACHINE HEAD CLEAN
	2. WIPE MILL ARBOR CLEAN
	3. INSERT TAPER END OF ARBOR INTO PROPER PLACE IN MACHINE
	4. HAND SCREW DRAW BAR INTO ARBOR FROM BACK OF MILLING MACHINE NOTE: THE DRAW BAR THREADS MUST SCREW INTO ARBOR AT LEAST 1"
	5. TIGHTEN DRAW BAR INTO ARBOR WITH WRENCH NOTE: THE DRAW BAR WILL SECURE THE TAPER ON ARBOR INTO TAPER ON MACHINE NOTE: BE SURE NOTCHES ON ARBOR SHOULDER ARE FITTED OVER HEAD LOCKING KEYS BEFORE TIGHTENING DRAW BAR
	6. UNSCREW NUT FROM END OF ARBOR
2. INSTALL CUTTERS	1. REMOVE 1/2 THE SPACERS
	2. MOUNT CUTTERS NEAR MIDDLE OF ARBOR
	3. SLIDE ONE 5" X 3/4" X 1" MILL CUTTER ONTO ARBOR NOTE: BE SURE CUTTER IS NOT ON BACKWARDS. IT MUST ROTATE PROPERLY ACCORDING TO THE DIRECTION OF TRAVEL
	4. KEY CUTTER TO ARBOR
	5. SLIDE 11/16" SPACING COLLAR ONTO

2.	INSTALL CUTTERS (CON'T.)		ARBOR
		6.	SLIDE SECOND MILL CUTTER ONTO ARBOR
		7.	MOUNT TO MATCH FIRST CUTTER
		8.	KEY CUTTER TO ARBOR
		9.	SLIDE 2" OF SPACERS ONTO ARBOR
		10.	SLIDE LARGE SPACER ONTO ARBOR NOTE: THIS SPACER WILL FIT INTO ARBOR SUPPORT TO SUPPORT END OF ARBOR
		11.	SLIDE ON SPACERS NECESSARY TO HIDE 1/4" OF THREADS
		12.	SCREW ARBOR NUT BACK ON ARBOR
		13.	TIGHTEN ARBOR NUT SECURELY
3.	SET UP OVERARM	1.	LOOSEN OVERARM LOCKING NUTS AT SIDE OF MACHINE
		2.	PLACE PROPER WRENCH ON OVERARM MOVEMENT NUT
		3.	TURN WRENCH TO MOVE OVERARM PAST MILL CUTTERS TO NEAR THE END OF ARBOR
		4.	TIGHTEN OVERARM LOCKING NUTS
4.	SET UP ARBOR SUPPORT	1.	SLIDE ARBOR SUPPORT ONTO OVERARM DOVE TAIL NOTCHES NOTE: SLIDE ON UNTIL LARGE SPACER ON ARBOR IS AT CENTER OF HOLE IN ARBOR SUPPORT
		2.	TIGHTEN ARBOR SUPPORT NUT
		3.	ARBOR MUST REVOLVE FREELY IN ARBOR SUPPORT
		4.	FILL OILER ON ARBOR SUPPORT WITH PROPER LUBRICATING OIL
5.	SET SPEED	1.	SEE RECOMMENDED CUTTING SPEEDS, REF. #1, P. 38-16
		2.	SET MACHINE SPEED TO ABOUT 60 FEET PER MINUTE
6.	SET FEED		SET FEED ON MACHINE TO .050" PER REVOLUTION
7.	SET DIALS	1.	LOOSEN LOCKING SCREWS ON ALL FOUR FEED DIALS
		2.	SET ALL DIALS ON 0"

7. SET DIALS (CON'T.)	3. TIGHTEN LOCKING SCREWS
8. SET STOPS	1. LOOSEN STOP NUTS ON TABLE 2. ADJUST STOP TO SHUT OFF AUTOMATIC FEED AFTER CUTTERS CLEAR END OF WORK BY 1/4" 3. TIGHTEN STOP NUTS
9. SET TABLE LOCKING NUTS	LOOSEN ALL TABLE LOCKING NUTS

SKETCHES: DRAWING #4: T-NUT

REFERENCES: REF. #1, PP. 38-1 TO 38-37
REF. #2, PP. 524-564

TASK SHEET

JOB: M-1
TASK: 3
PAGE: 1

TASK: MOUNT WORK IN VISE

JOB: MAKE T-NUT

TRADE: MACHINIST

TOOLS AND MATERIALS: MILLING MACHINE, MILLING MACHINE VISE, PARALLEL BARS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHECK VISE	1. PARALLEL TO TABLE
	2. TIGHTEN WITH WRENCH
2. MOUNT WORK	1. OPEN VISE 1 1/2"
	2. PLACE PROPER PARALLEL BARS IN VISE
	3. PLACE WORK PIECE ON PARALLEL BAR
	a. LAID OUT SURFACE UP
	b. BOTTOMS OF NOTCH LAYOUT 3/8" ABOVE VISE JAWS
	4. TAP TOP OF WORK PIECE WITH HAMMER TO SET PROPERLY ON PARALLELS
	5. LEAVE WORK UNPROTECTED
	6. CLOSE VISE TIGHT

SKETCHES: DRAWING #4: T-NUT

REFERENCES: REF. #1, PP. 38-18 TO 38-19
REF. #2, PP. 535-536

TASK SHEET

JOB: M-1
TASK: 4
PAGE: 1

TASK: MILL WORK PIECE

JOB: MAKE T-NUT

TRADE: MACHINIST

TOOLS AND MATERIALS: MILLING MACHINE, CHECKED OUT, AND SET UP, MILLING MACHINE VISE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MAKE FINAL ADJUSTMENTS	1. PUT ON SAFETY GOGGLES
	2. RAISE TABLE UNTIL CUTTERS ARE 1/4" ABOVE AND CENTERED OVER LAYOUT LINES
	3. START CUTTER MOTOR NOTE: BE SURE CUTTERS ARE REVOLVING THE RIGHT DIRECTION, REF. #1, PP. 38-22
	4. RAISE TABLE UNTIL CUTTERS JUST TOUCH WORK
	5. DROP TABLE AND CHECK TO SEE IF CUTTERS ARE CENTERED ON BOTH LAYOUT LINES NOTE: IF CUTTERS ARE NOT CENTERED MOVE TABLE IN OR OUT TO CENTER
	6. RAISE TABLE UNTIL CUTTERS BARELY TOUCH WORK
	7. MOVE THE TABLE BACK UNTIL WORK CLEARS FRONT OF CUTTERS
	8. RAISE TABLE 9/32" OR .281" NOTE: USE DIAL
	9. TIGHTEN LOCKING NUT ON KNEE
	10. TIGHTEN LOCKING NUT FOR TABLE MOVEMENT IN AND OUT (CROSS SLIDE) NOTE: LONGITUDINAL LOCKING NUTS MUST BE LEFT LOOSE
	11. START OIL PUMP
	12. START FEED MOTOR

2. MILL NOTCHES	1. ENGAGE FEED LEVER NOTE: AFTER THE MACHINE HAS COMPLETED ITS CUT, THE TABLE STOP WILL AUTOMATICALLY DISENGAGE THE FEED LEVER
	2. STOP THE MACHINE
3. REMOVE WORK	1. LOOSEN VISE
	2. REMOVE WORK
4. CLEAN MACHINE	1. REMOVE CUTTERS, CLEAN AND RETURN TO PROPER PLACE
	2. REMOVE ARBOR, CLEAN AND STORE
	3. REMOVE ALL CHIPS WITH BRUSH
	4. WIPE MACHINE CLEAN
	5. DISPOSE WASTE IN CONTAINER

ROUTE TO BENCH

SKETCHES: DRAWING #4: T-NUT

REFERENCES: REF. #1, PP. 38-1 TO 38-3
REF. #2, PP. 254-264

B-4c

JOB SHEET
IN
BENCH WORK

JOB:	MAKE T-NUT
MATERIALS:	WORK PIECE 3/4" X 1 1/4" X 6 1/2" COLD ROLLED STEEL
TOOLS AND EQUIPMENT:	BENCH VISE, HAND HACKSAW (18 TOOTH BLADE), 10" MILL FILE, DOUBLE SQUARE, 0-1" MICROMETER, 1-2" MICROMETER, 0-1" DEPTH MICROMETER, VERNIER CALIPER
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #1, "SAWING METALS BY HAND", PP. 9-1 TO 9-5, AND REF. #2, "HAND SAWING", PP. 84-89. CHECK WITH INSTRUCTOR AT FREQUENT INTERVALS.
PROCEDURES AND/OR TASKS:	B-4c-1 PART INDIVIDUAL PIECES B-4c-2 SQUARE ENDS B-4c-3 POLISH, REFER TO CLAMP STRAP, JOB B-1b
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CORRECT SETUP AND USE OF HAND HACKSAW.
2. HOLD ALL DIMENSIONS TO DRAWING SPECIFICATIONS.
3. FLAT SURFACES ARE SQUARE AND PARALLEL.
4. FINISH MEETS STANDARD REQUIRED.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: B-4c
TASK: 1
PAGE: 1

TASK:	PART INDIVIDUAL PIECES
JOB:	MAKE T-NUT
TRADE:	MACHINIST
TOOLS AND MATERIALS:	BENCH VISE, HAND HACKSAW (18 TOOTH BLADE), WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK	1. OPEN BENCH VISE 1 1/2" 2. PLACE WORK IN VISE WITH NOTCHES UP 3. WORK PARALLEL TO TABLE 4. EXTEND WORK 2" OUTSIDE VISE 5. PROTECT WORK 6. TIGHTEN VISE
2. SELECT HAND HACKSAW	1. BLADE WITH 18 TEETH PER INCH 2. TEETH POINT AWAY FROM HANDLE 3. CORRECT TENSION
3. PART FIRST AND SECOND T-NUTS	1. REFER TO CLAMP STRAP, JOB B-1a, TASK 1, FOR BODY POSITION 2. SAW FIRST T-NUT AT 1 1/2" FROM END NOTE: SAW EXACTLY ON CENTER OF SCRIBE MARK
4. PART SECOND AND THIRD T-NUTS	1. REPEAT STEP 1 2. REPEAT STEP 2
5. PART THIRD AND FOURTH T-NUTS	1. REPEAT STEP 1 2. REPEAT STEP 2 NOTE: LAST T-NUT IN VISE SHOULD BE PROPER LENGTH

SKETCHES: DRAWING #4: T-NUT

REFERENCES: REF. #1, PP. 9-1 TO 9-5
REF. #2, PP. 84-89

TASK SHEET

JOB: B-4c
TASK: 2
PAGE: 1

TASK: SQUARE ENDS

JOB: MAKE T-NUT

TRADE: MACHINIST

TOOLS AND MATERIALS: BENCH VISE, SMOOTH MILL FILE, DOUBLE SQUARE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK IN VISE	1. OPEN VISE TO ABOUT 1" 2. MOUNT ONE T-NUT PERPENDICULAR TO TABLE 3. PROTECT WORK 4. MOUNT WITH TOP END 2" ABOVE VISE JAWS 5. TIGHTEN VISE
2. SQUARE ENDS OF FIRST T-NUT	1. FLAT FILE END SQUARE TO MINIMUM CLEAN UP 2. END MUST BE SQUARE TO ALL FOUR SIDES 3. OPEN VISE 4. REPEAT PREVIOUS STEPS TO SQUARE OPPOSITE END
3. SQUARE ENDS OF THREE REMAINING T-NUTS	REPEAT STEPS 1 AND 2
4. INSPECT	1. 11/16" WIDTH 2. 9/32" DEPTH 3. 15/32" THICKNESS 4. LOCATION OF HOLES (USE VERNIER CALIPER) 5. FINISH

SKETCHES: DRAWING #4: T-NUT

REFERENCES: REF. #1, PP. 17-1 TO 17-7
REF. #2, PP. 113-117

MACHINE SHOP STEP BLOCK

BENCH	5
MILLING	2
SHAPER	3

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND CONSTRUCT A STEP BLOCK ACCORDING TO SPECIFICATIONS; USING THE VARIOUS MACHINES, TOOLS, AND EQUIPMENT CALLED FOR IN THE JOB.

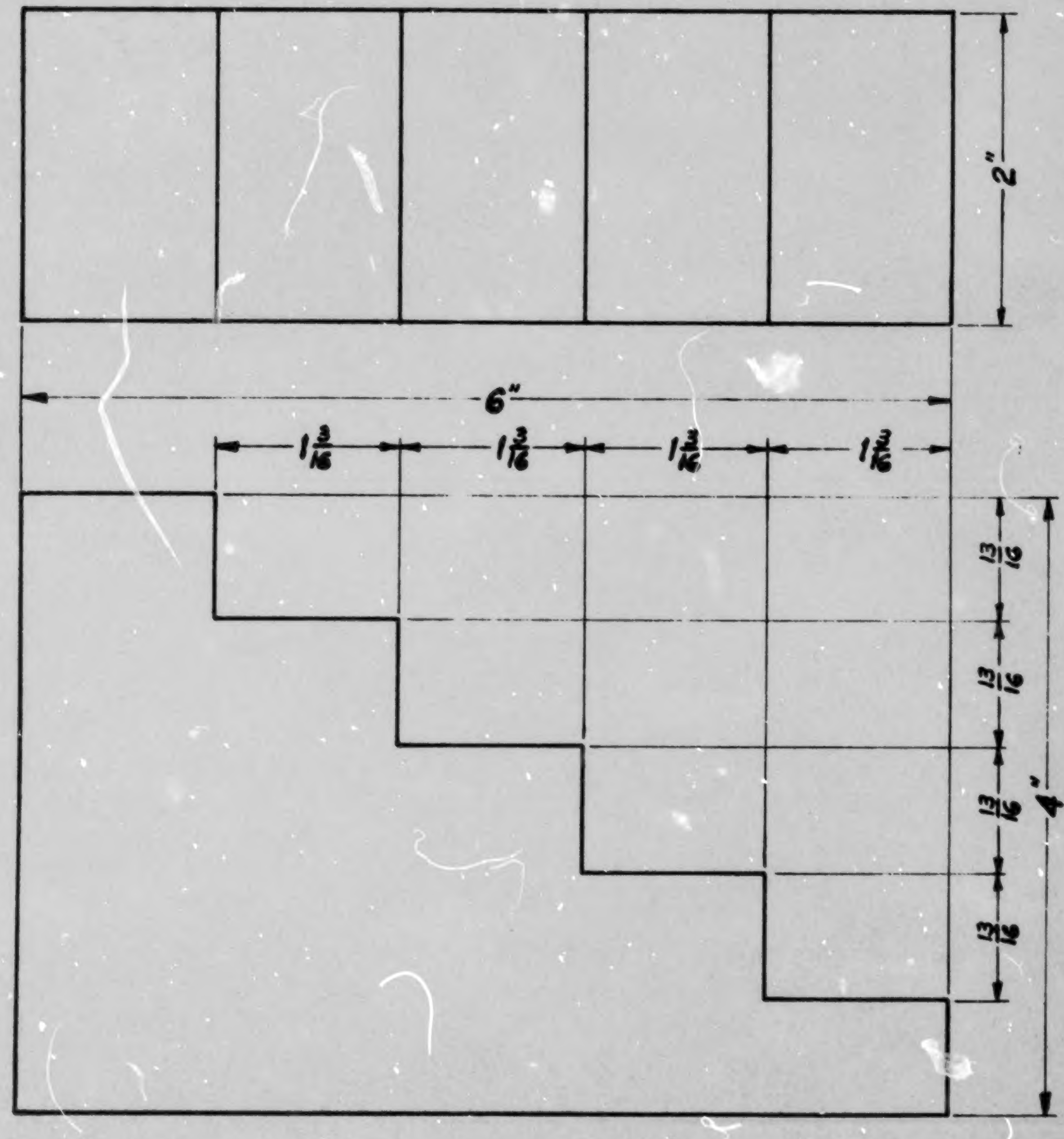
CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINES FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATION AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, AND MACHINES.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1, WALKER, JOHN R., *MODERN METALWORKING.*

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, *METALWORK TECHNOLOGY AND PRACTICE.*


2"
6"
1 3/16
1 3/16
1 3/16
1 3/16
13/16
13/16
13/16
13/16
4"

DRAWING NO. 5	STEP BLOCK	TOLERANCE CHART
MILLING JOB NO. 2 SHAPER JOB NO. 3	MATERIAL: CAST IRON FINISH: MACHINE SCALE: FULL SIZE	FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1/2°

S-3a

JOB SHEET
IN
SHAPER

JOB: MAKE STEP BLOCK

MATERIALS: WORK PIECE 2 1/4" X 4 1/4" X 6 1/4" CAST IRON

TOOLS AND EQUIPMENT: SHAPER, SHAPER VISE, TWO SHAPER TOOL BITS GROUND FOR RIGHT AND LEFT HAND CUTTING, SHAPER TOOL HOLDER, 10" MILL FILE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, "PLANING MACHINES", PP. 37-1 TO 37-16 AND REF. #2, "THE SHAPER AND SHAPER OPERATIONS", PP. 499-523. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE. FOR BENCH WORK REFER TO CLAMP STRAP, JOBS B-1a AND B-1b.

PROCEDURES AND/OR TASKS:

S-3a-1	CHECK THE SHAPER FOR PROPER RUNNING CONDITIONS, DRILL DRIFT, S-1-1
S-3a-2	SET UP SHAPER, DRILL DRIFT, S-1-2
S-3a-3	MACHINE WORK PIECE ON SIDES, EDGES, AND ENDS

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. PROPER MACHINE SETUP.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. SMOOTH MACHINE FINISH.
4. ALL THE SURFACES SQUARE AND PARALLEL TO EACH OTHER.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: S-3a
TASK: 3
PAGE: 1

TASK: MACHINE WORK PIECE ON SIDES, EDGES, AND ENDS

JOB: MAKE STEP BLOCK

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, SHAPER TOOL HOLDER, SHAPER TOOL BIT, 10" MILL FILE, SHAPER VISE, BENCH VISE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. ROUGH MACHINE FLAT SURFACE	1. PUT ON GOGGLES
	2. START MOTOR
	3. ENGAGE RAM CLUTCH
	4. RAISE MACHINE UNTIL CUTTING TOOL SCRATCHES THE TOP SURFACE OF WORK PIECE
	5. DISENGAGE RAM CLUTCH, WITH TOOL AT STARTING POINT OF STROKE
	6. MOVE TABLE, BY HAND, TO SIDE UNTIL TOOL IS COMPLETELY OFF WORK NOTE: BE SURE TO MOVE TABLE TO SIDE WHERE CUTTING EDGE OF TOOL WILL BE THE FIRST PART OF TOOL TO CONTACT SURFACE OF METAL TO BE CUT
	7. LOWER TOOL HEAD .100"
	8. LOCK TOOL HEAD
	9. ENGAGE RAM CLUTCH
	10. HAND FEED TABLE UNTIL TOOL BEGINS TO CUT
	11. ENGAGE AUTOMATIC FEED
	12. CUT ENTIRE TOP SURFACE
	13. DISENGAGE RAM CLUTCH WITH TOOL AT STARTING POSITION OF CUT
	14. HAND FEED TABLE BACK TO STARTING POSITION
2. FINISH MACHINE FLAT SURFACE	1. LOOSEN TOOL HEAD
	2. LOWER TOOL HEAD .025 INCH AND TIGHTEN
	3. SLOW FEED DOWN TO .010" PER CUT

2.	FINISH MACHINE FLAT SURFACE (CON'T.)	4.	TAKE FINISH CUT IN SAME MANNER AS ROUGHING CUT, STEP 1
		5.	STOP MACHINE
		6.	REMOVE WORK FROM VISE
3.	REMOVE BURRS	1.	MOUNT IN BENCH VISE
		2.	FILE BURRS
4.	SET MACHINE TO CUT SECOND SIDE	1.	CLEAN INSIDE OF VISE WITH RAG
		2.	SET WORK BACK IN VISE WITH MACHINED SURFACE DOWN
		3.	TIGHTEN VISE
		4.	LOOSEN LOCK NUT ON TOOL HEAD
		5.	LOWER TOOL HEAD .100"
		6.	RESET FEED TO REMOVE .020" PER CUT
5.	ROUGH MACHINE SECOND SIDE	1.	ENGAGE RAM CLUTCH
		2.	ENGAGE AUTOMATIC FEED
		3.	MACHINE SECOND SIDE
		4.	DISENGAGE RAM CLUTCH
		5.	HAND CRANK TABLE BACK TO STARTING POSITION
6.	FINISH MACHINE SECOND SIDE	1.	LOOSEN TOOL HEAD
		2.	LOWER TOOL HEAD .025" AND TIGHTEN
		3.	SLOW FEED DOWN TO .010" PER CUT
		4.	TAKE FINISH CUT AS IN STEP 2
		5.	LOOSEN VISE
		6.	REMOVE WORK
7.	REMOVE BURRS		USE FILE, SAME AS STEP 3
8.	ROUGH MACHINE FIRST EDGE	1.	LOWER TABLE 4"
		2.	CLEAN INSIDE OF VISE
		3.	REMOVE PARALLEL BARS
		4.	LOOSEN VISE AND TURN UNTIL JAWS ARE PARALLEL TO RAM
		5.	SNUG VISE NUTS
		6.	INDICATE TRUE WITH DIAL INDICATOR
		7.	TIGHTEN VISE NUTS
		8.	RECHECK TO BE SURE VISE IS STILL TRUE
		9.	CHECK TOOL, SHARPEN IF NECESSARY
		10.	SET MACHINE AS IN STEP 1
		11.	REMOVE .100" OF MATERIAL
		12.	SET FEED TO .020" PER CUT

9.	FINISH MACHINE FIRST EDGE	1. REPEAT STEP 2 2. SET FEED AT .010" PER CUT
10.	REMOVE BURRS	SAME AS STEP 3
11.	ROUGH MACHINE SECOND EDGE	1. REPEAT STEP 1 2. REMOVE .100" FROM EDGE OF WORK 3. SET FEED AT .020" PER CUT
12.	FINISH MACHINE SECOND EDGE	1. REPEAT STEP 2 2. SET FEED AT .010" PER CUT
13.	REMOVE BURRS	SAME AS STEP 3
14.	ROUGH MACHINE FIRST END	1. REPEAT STEP 1 2. REMOVE .100" FROM END 3. SET FEED ON .020" PER CUT
15.	FINISH MACHINE FIRST END	1. REPEAT STEP 2 2. SET TO REMOVE .025" FROM END OF WORK 3. SET FEED ON .010" PER CUT
16.	REMOVE BURRS	SAME AS STEP 3
17.	FINISH MACHINE SECOND END	1. REPEAT SETUP AS BEFORE 2. SET FEED ON .010" PER CUT
18.	REMOVE BURRS	1. REPEAT STEP 3 2. WIPE VISE CLEAN 3. RETURN FILE TO PROPER PLACE 4. CLEAN WORK STATION

ROUTE TO BENCH FOR LAYOUT

SKETCHES: DRAWING #5: STEP BLOCK

REFERENCES: REF. #1, PP. 37-1 TO 37-16
REF. #2, PP. 499-523

OPTIONAL HM-2

JOB SHEET
IN
MILLING MACHINE

JOB:	MAKE STEP BLOCK	
MATERIALS:	WORK PIECE 2 1/4" X 4 1/4" X 6 1/4" CAST IRON	
TOOLS AND EQUIPMENT:	HORIZONTAL MILLING MACHINE, MILLING MACHINE VISE, HELICAL SLAB MILLING CUTTER, 10" MILL FILE	
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #1, PP. 38-1 TO 38-37 AND REF. #2, PP. 524-564. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.	
PROCEDURES AND/OR TASKS:	HM-2-1	CHECK MACHINE FOR PROPER RUNNING CONDITION. T-NUT M-1-1
	HM-2-2	MOUNT WORK IN HORIZONTAL MILL VISE
	HM-2-3	SET UP MACHINE FOR MILLING
	HM-2-4	MILL WORK PIECE
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.	

1. PROPER MACHINE SETUP.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. SMOOTH MACHINE FINISH.
4. ALL SURFACES SQUARE AND PARALLEL TO EACH OTHER.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: HM-2
TASK: 2
PAGE: 1

TASK: MOUNT WORK IN HORIZONTAL MILL VISE

JOB: MAKE STEP BLOCK

TRADE: MACHINIST

TOOLS AND MATERIALS: HORIZONTAL MILLING MACHINE, WORK PIECE, HORIZONTAL MILL VISE, PARALLEL BARS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHECK VISE	1. PARALLEL TO TABLE 2. TIGHTEN WITH WRENCH
2. MOUNT WORK	1. OPEN VISE 4" 2. PLACE PROPER PARALLEL BARS IN VISE 3. LAY WORK PIECE FLAT ON PARALLEL BARS 4. SURFACE OF WORK 1/4" ABOVE VISE JAWS 5. LEAVE WORK UNPROTECTED 6. TIGHTEN VISE

SKETCHES: DRAWING #5: STEP BLOCK

REFERENCES: REF. #1, PP. 38-1 TO 38-37
REF. #2, PP. 524-564

TASK SHEET

JOB: HM-2
TASK: 3
PAGE: 1

TASK: SET UP MACHINE FOR MILLING

JOB: MAKE STEP BLOCK

TRADE: MACHINIST

TOOLS AND MATERIALS: HORIZONTAL MILLING MACHINE, HELICAL SLAB MILL CUTTER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MILL ARBOR	1. CLEAN ARBOR. SEE T-NUT M-1-3 2. REMOVE ALL CUTTERS 3. PLACE HELICAL SLAB MILL CUTTER IN MIDDLE OF ARBOR 4. COMPLETE SETUP AS IN T-NUT M-1-3
2. OVERARM	SEE T-NUT M-1-3
3. ARBOR SUPPORT	SEE T-NUT M-1-3
4. SPEED	SET AT 60 RPM
5. FEED	SET AT .015" PER REVOLUTION
6. DIALS	1. LOOSEN LOCKING SCREWS 2. SET DIALS ON "0" 3. TIGHTEN LOCKING SCREWS
7. TABLE LOCKING NUTS	ALL NUTS LOOSE

SKETCHES: DRAWING #5: STEP BLOCK

REFERENCES: REF. #1, PP. 38-1 TO 38-37
REF. #2, PP. 524-564

TASK SHEET

JOB: HM-2
TASK: 4
PAGE: 1

TASK: MILL WORK PIECE

JOB: MAKE STEP BLOCK

TRADE: MACHINIST

TOOLS AND MATERIALS: HORIZONTAL MILLING MACHINE, HORIZONTAL MILLING VISE, PARALLEL BARS, HELICAL SLAB MILL CUTTER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MAKE FINAL ADJUSTMENTS	1. PUT ON SAFETY GOGGLES 2. RAISE TABLE UNTIL SLAB MILL CUTTER IS 1/4" ABOVE WORK PIECE 3. START CUTTER MOTOR __NOTE__: BE SURE CUTTER IS REVOLVING IN PROPER DIRECTION. SEE REF. #1, PP. 38-22 4. RAISE TABLE SLOWLY UNTIL CUTTER CONTACTS WORK 5. TURN TABLE HAND CRANK 6. USE DIAL TO RAISE TABLE .125" 7. TIGHTEN LOCK NUT ON KNEE 8. TIGHTEN LOCK NUT ON CROSS SLIDE 9. START FEED MOTOR __NOTE__: THIS IS CAST IRON AND WILL NOT NEED OILING
2. MILL FIRST SIDE	1. ENGAGE FEED LEVER FOR TABLE __NOTE__: THE MACHINE FEED WILL STOP WHEN IT COMPLETES CUT 2. STOP ALL MACHINE MOTORS
3. REMOVE BURRS	1. LOOSEN VISE 2. REMOVE WORK PIECE 3. DEBURR SHARP EDGES WITH FILE
4. PREPARE VISE FOR SECOND SIDE	1. REMOVE PARALLEL BARS 2. WIPE INSIDE OF VISE CLEAN WITH RAG 3. WIPE PARALLEL BARS CLEAN WITH RAG

5.	SET UP TO MILL SECOND SIDE	1. REPLACE PARALLEL BARS 2. REPLACE WORK PIECE AS IN HM-2-2 NOTE: FINISH SIDE DOWN 3. USE DIAL TO RAISE TABLE .125" 4. START CUTTER MOTOR 5. START FEED MOTOR
6.	MILL SECOND SIDE	1. ENGAGE FEED LEVER AS BEFORE UNTIL CUT IS COMPLETE 2. STOP ALL MACHINE MOTORS
7.	REMOVE BURRS	REPEAT STEP 3
8.	PREPARE VISE TO MACHINE FIRST EDGE	1. REMOVE PARALLEL BARS 2. WIPE INSIDE OF VISE CLEAN WITH RAG 3. WIPE PARALLEL BARS CLEAN NOTE: THE PARALLEL BARS WILL NO LONGER BE USED
9.	SET UP TO MILL EDGE	1. MOUNT WORK IN VISE WITH ONE EDGE UP 2. TIGHTEN VISE 3. LOWER TABLE WITH HAND CRANK UNTIL WORK IS LOWER THAN BOTTOM OF CUTTER 4. MOVE TABLE OVER UNTIL WORK PIECE IS UNDER CUTTER 5. START CUTTER MOTOR 6. RAISE TABLE UNTIL CUTTER MAKES CONTACT 7. USE HAND TABLE FEED CRANK TO MAKE TABLE TOWARDS END UNTIL CUTTER CLEARS WORK 8. RAISE CUTTER .125" 9. START TABLE FEED MOTOR
10.	MILL FIRST EDGE	1. ENGAGE FEED LEVER FOR TABLE FEED 2. MACHINE EDGE TO 100% CLEAN UP
11.	REMOVE BURRS	REPEAT STEP 3
12.	PREPARE VISE FOR SECOND EDGE	REPEAT STEP 4
13.	SET UP TO MILL SECOND EDGE	REPEAT STEP 9
14.	MILL SECOND EDGE	1. SET TO REMOVE .125" 2. ENGAGE FEED LEVER FOR TABLE FEED

15.	REMOVE BURRS		REPEAT STEP 3
16.	PREPARE TO MILL ENDS	1.	REPEAT STEP 4
		2.	LOWER TABLE 2 1/2"
		3.	SET TABLE FEED STOP TO DISENGAGE FEED 1/4" FROM END OF CUT
17.	MILL ENDS	1.	REPEAT STEPS 5 AND 6
		2.	STOP ALL MACHINE MOTORS
18.	REMOVE BURRS		REPEAT STEP 3
19.	CLEAN MILL	1.	LOWER MILL TABLE ABOUT 10"
		2.	REMOVE CUTTER, CLEAN AND RETURN TO PROPER PLACE
		3.	REMOVE ARBOR, CLEAN AND STORE
		4.	REMOVE ALL CHIPS WITH BRUSH
		5.	WIPE MACHINE CLEAN
		6.	DISPOSE OF ALL WASTE

ROUTE TO BENCH

SKETCHES: DRAWING #5: STEP BLOCK

REFERENCES: REF. #1, PP. 38-1 TO 38-37
REF. #2, PP. 524-564

B-5

JOB SHEET
IN
BENCH WORK

JOB: MAKE STEP BLOCK

MATERIALS: WORK PIECE 2" X 4" X 6" CAST IRON MILLED

TOOLS AND EQUIPMENT: LAYOUT FLUID, COMBINATION SQUARE, SCRIBE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, PP. 6-1 TO 6-10 AND REF. #2, PP. 62-66. CHECK WITH INSTRUCTOR AT FREQUENT INTERVALS.

PROCEDURES AND/OR TASKS: B-5-1 LAYOUT TO SPECIFICATIONS

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THIS INDICATED POINT.

1. HOLD TO SPECIFICATIONS.

TASK SHEET

JOB: B-5a
TASK: 1
PAGE: 1

TASK: LAYOUT TO SPECIFICATIONS

JOB: MAKE STEP BLOCK

TRADE: MACHINIST

TOOLS AND MATERIALS: LAYOUT FLUID, COMBINATION SQUARE, SCRIBE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. APPLY LAYOUT FLUID	1. COAT ONE SIDE OF WORK PIECE 2. ALLOW TO DRY
2. FIRST STEP FROM EDGE	1. SET COMBINATION SQUARE ON 3/4" 2. POSITION SQUARE HEAD ON EITHER EDGE 3. PLACE RULE FLAT ON INKED SURFACE 4. POSITION SCRIBE AT END OF RULE 5. SCRIBE A LINE 1 1/4" LONG FROM EITHER END OF PART
3. SECOND STEP FROM EDGE	1. SET COMBINATION SQUARE ON 1 9/16" 2. SCRIBE LINE 2 1/2" LONG FROM SAME END AS FIRST LINE
4. THIRD STEP FROM EDGE	1. SET COMBINATION SQUARE ON 2 3/8" 2. SCRIBE LINE 3 5/8" LONG FROM SAME END AS BEFORE
5. FOURTH STEP FROM EDGE	1. SET COMBINATION SQUARE ON 3 3/16" 2. SCRIBE LINE 5" LONG FROM SAME END
6. FIRST STEP FROM END	1. SET COMBINATION SQUARE ON 1 3/16" 2. POSITION SQUARE HEAD AGAINST END OF WORK FROM WHICH ALL PREVIOUS LAYOUT LINES START 3. PLACE RULE FLAT ON LAYOUT SURFACE 4. SCRIBE LINE CONNECTING THE SCRIBE LINES DRAWN IN STEPS 2 AND 3
7. SECOND STEP FROM END	1. SET COMBINATION SQUARE ON 2 3/8" 2. SCRIBE LINE CONNECTING THE SCRIBE

7.	SECOND STEP FROM END (CON'T.)	LINES DRAWN IN STEPS 3 AND 4
8.	FOURTH STEP FROM END	1. SET COMBINATION SQUARE ON 4 3/4" 2. REPEAT STEPS 2 AND 3 ABOVE 3. SCRIBE LINE CONNECTING THE SCRIBE LINE DRAWN IN STEP 5 AND EDGE OF PART 4. RETURN LAYOUT EQUIPMENT TO PROPER PLACE

ROUTE TO VERTICAL MILL

SKETCHES: DRAWING #5: STEP BLOCK

REFERENCES: REF. #1, PP. 17-1 TO 17-7
REF. #2, PP. 113-117

OPTIONAL VM-2

JOB SHEET
IN
MILLING MACHINE

JOB:	MAKE STEP BLOCK	
MATERIALS:	WORK PIECE 2 1/4" X 4 1/4" X 6 1/4" CAST IRON	
TOOLS AND EQUIPMENT:	VERTICAL MILLING MACHINE, MILLING MACHINE VISE, 10" MILL FILE, TWO T-BOLTS, END MILL, ALLEN WRENCH, 0-6" MICROMETER, 0-6" DEPTH MICROMETER	
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #1, PP. 38-1 TO 38-35 AND REF. #2, PP. 555-558. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.	
PROCEDURES AND/OR TASKS:	VM-2-1	CHECK MACHINE FOR PROPER RUNNING CONDITIONS T-NUT, M-1-1
	VM-2-2	MOUNT WORK IN VISE
	VM-2-3	SET UP MACHINE FOR MILLING
	VM-2-4	MILL WORK PIECE
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.	

1. PROPER MACHINE SETUP.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. SMOOTH MACHINE FINISH.
4. ALL SURFACES SQUARE AND PARALLEL TO EACH OTHER.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: VM-2
TASK: 2
PAGE: 1

TASK: MOUNT WORK IN VISE

JOB: MAKE STEP BLOCK

TRADE: MACHINIST

TOOLS AND MATERIALS: VERTICAL MILLING MACHINE, MILLING MACHINE VISE, TWO T-BOLTS, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. PLACE VISE ON MILL TABLE	1. WIPE MILL TABLE CLEAN 2. WIPE BOTTOM OF VISE 3. PLACE VISE ON MILL TABLE 4. VISE JAWS PARALLEL TO TABLE
2. BOLT VISE	1. TRUE VISE VISUALLY 2. INSERT TWO "T" BOLTS IN "T" SLOT NEAREST MACHINE COLUMN 3. SLIDE "T" BOLTS INTO SIDE NOTCHES ON VISE 4. SCREW PROPER NUTS ON "T" BOLTS TIGHT ENOUGH TO HOLD IN PLACE
3. INDICATE VISE	1. MOUNT DIAL INDICATOR ON COLUMN OR VERTICAL HEAD 2. OPEN VISE JAWS 3" 3. SET DIAL INDICATOR TO INDICATE VISE TRUE 4. TRUE VISE 5. TIGHTEN NUTS ON "T" BOLTS TIGHT 6. RECHECK VISE WITH INDICATOR TO BE SURE IT DID NOT MOVE WHEN TIGHTENING NUTS
4. MOUNT WORK	1. OPEN VISE 2. PLACE PROPER PARALLEL BARS IN VISE 3. MOUNT WORK ON EDGE 4. LAID OUT SURFACE VISIBLE 5. 3/4" OF WORK PIECE IN VISE 6. TIGHTEN VISE

SKETCHES: DRAWING #5: STEP BLOCK

REFERENCES: REF. #1, P. 38-22

TASK SHEET

JOB: VM-2
TASK: 3
PAGE: 1

TASK: SET UP MACHINE FOR MILLING

JOB: MAKE STEP BLOCK

TRADE: MACHINIST

TOOLS AND MATERIALS: VERTICAL MILLING MACHINE, END MILL, MILLING MACHINE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT END MILL HOLDER	1. WIPE FEMALE SPINDLE TAPER ON MACHINE HEAD
	2. SELECT PROPER END MILL HOLDER
	3. WIPE END MILL HOLDER
	4. INSERT THE TAPER END OF END MILL HOLDER INTO TAPERED SPINDLE ON HEAD
	5. INSERT DRAW BAR THROUGH MACHINE HEAD
	6. TIGHTEN THE DRAW BAR WITH PROPER WRENCH
2. MOUNT END MILL	1. SELECT PROPER SHARP END MILL NOTE: BE SURE SHANK SIZE IS SAME AS END MILL HOLDER
	2. INSERT END MILL INTO END MILL HOLDER, SHANK FIRST
	3. WRAP THE SHARP CUTTER WITH RAG TO AVOID BEING CUT
	4. SELECT PROPER ALLEN WRENCH TO TIGHTEN END MILL
	5. ADJUST END MILL UNTIL FLAT ON SHANK IS UNDER SET SCREW
	6. TIGHTEN ALLEN SET SCREW WITH ALLEN WRENCH
3. SET SPEED	SET CUTTER SPEED TO 60 RPM
4. SET FEED	SET FEED TO REMOVE .015" PER REVOLUTION

SKETCHES: DRAWING #5: STEP BLOCK

REFERENCES: REF. #1, PP. 38-9 TO 38-10
REF. #2, PP. 555-558

TASK SHEET

JOB: VM-2
TASK: 4
PAGE: 1

TASK: MILL WORK PIECE

JOB: MAKE STEP BLOCK

TRADE: MACHINIST

TOOLS AND MATERIALS: VERTICAL MILLING MACHINE, VERTICAL MILLING MACHINE VISE, END MILL, 10" MILL FILE, 0-6" MICROMETER, 0-6" DEPTH MICROMETER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MAKE FINAL ADJUSTMENTS	1. LOWER TABLE UNTIL END MILL IS ABOVE WORK PIECE
	2. MOVE TABLE TO SIDE UNTIL END MILL IS OVER TOP OF WORK
	3. PUT ON SAFETY GOGGLES
	4. START CUTTER MOTOR
	5. RAISE TABLE UNTIL CUTTER TOUCHES WORK
	6. MOVE TABLE TOWARD END UNTIL CUTTER IS OFF WORK NOTE: BE SURE IT IS OFF END LAID OUT TO BE CUT
	7. RAISE TABLE .750" FOR ROUGHING FIRST STEP
	8. MOVE TABLE IN AND TOWARD END UNTIL CUTTER IS ON SIDE OF WORK NEXT TO OPERATOR
	9. MOVE THE TABLE OUT UNTIL CUTTER TOUCHES WORK
	10. MOVE TABLE TOWARD END UNTIL CUTTER IS TO SHOULDER OF STEP NOTE: THE DIRECTION TO MOVE THE TABLE DEPENDS ON THE ROTATION OF CUTTER AND DIRECTION OF TRAVEL. USE CONVENTIONAL CUT RATHER THAN CLIMB CUT
	11. TIGHTEN KNEE CLAMP AND SADDLE CLAMP

2. ROUGH MILL FIRST STEP	1. ENGAGE TABLE FEED LEVER 2. ROUGH FIRST STEP OFF COMPLETELY NOTE: OIL SHOULD NOT BE USED ON CAST IRON 3. LEAVE SOME METAL FOR FINISH CUT NOTE: IF EXCESSIVE VIBRATION OR CHATTER TAKES PLACE, STOP THE MACHINE. IT WILL BE CAUSED BY ONE OF THE FOLLOWING a. DEPTH OF CUT TOO DEEP b. RATE OF FEED TOO FAST c. CUTTER RPM TOO HIGH d. LOOSE CLAMPS e. LOOSE VISE BOLTS
3. FINISH MILL FIRST STEP	1. LOOSEN KNEE CLAMP 2. RAISE TABLE .062" BY THE DIAL 3. MILL ENTIRE FIRST STEP AND TO SHOULDER. HOLD SHOULDER DIMENSION TO 1 1/4" AS PER DRAWING
4. MILL SECOND STEP	REPEAT STEPS 2 AND 3
5. MILL THIRD STEP	REPEAT STEPS 2 AND 3
6. MILL FOURTH STEP	REPEAT STEPS 2 AND 3
7. CLEAN UP	1. STOP ALL MACHINE MOTORS 2. LOOSEN VISE 3. REMOVE WORK 4. REMOVE THE END MILL, CLEAN, AND STORE 5. BRUSH AND WIPE MACHINE CLEAN 6. CLEAN WORK AREA 7. DISPOSE OF WASTE
8. REMOVE BURRS	1. MOUNT WORK IN VISE STEPS UP 2. PROTECT WORK 3. FILE MACHINE BURRS
9. INSPECT	1. LENGTH - 6" 2. WIDTH - 4" 3. THICKNESS - 2" 4. STEP 1 1/4" 5. STEP 1 3/16" 6. STEP 13/16" 7. STEP 3/4"

SKETCHES: DRAWING #5: STEP BLOCK

REFERENCES: REF. #1, PP. 38-29 TO 38-32
REF. #2, PP. 555-558

JOB SHEET
IN
SHAPER

S-3b

JOB:	MAKE STEP BLOCK	
MATERIALS:	WORK PIECE 2" X 4" X 6" CAST IRON PROPERLY LAID OUT	
TOOLS AND EQUIPMENT:	SHAPER, SHAPER VISE, SURFACE GAUGE, SHAPER TOOL HOLDER, TWO SHAPER TOOLS GROUND FOR RIGHT AND LEFT HAND CUTTING, 10" MILL FILE	
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #1, "PLANING MACHINES" PP. 37-1 TO 37-16 AND SURFACE GAUGE" PP. 6-3 TO 6-4, REF. #2, "SHAPER OPERATION" PP. 499-523.	
PROCEDURES AND/OR TASKS:	S-3b-1	CHECK SHAPER FOR PROPER RUNNING CONDITIONS DRILL DRIFT, S-1-1
	S-3b-2	SET UP SHAPER
	S-3b-3	MACHINE STEPS
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK. 1. MACHINE VISE INDICATED TRUE. 2. ALL DIMENSIONS HELD TO SPECIFICATIONS. 3. SMOOTH MACHINE FINISH. 4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.	

TASK SHEET

JOB: S-3b
TASK: 2
PAGE: 1

TASK:	SET UP SHAPER
JOB:	MAKE STEP BLOCK
TRADE:	MACHINIST
TOOLS AND MATERIALS:	SHAPER, SHAPER VISE, TWO SHAPER TOOLS GROUND FOR RIGHT AND LEFT HAND CUTTING, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP VISE	1. LOOSEN VISE LOCKING NUTS
	2. SWIVEL VISE UNTIL JAWS ARE PERPENDICULAR TO RAM
	3. SNUG NUTS DOWN
	4. INDICATE VISE TRUE WITH DIAL INDICATOR
	5. TIGHTEN VISE NUTS TIGHT
	6. CHECK VISE WITH INDICATOR TO BE SURE IT DID NOT MOVE WHEN TIGHTENING NUTS
2. MOUNT WORK IN VISE	1. PLACE PROPER PARALLEL BARS IN VISE
	2. 5/8" OF WORK HELD IN VISE
	3. HAVE LAID OUT SURFACE FACING OPERATOR
	4. TIGHTEN VISE
3. CUTTING TOOL	1. SELECT PROPER CUTTING TOOL FOR ROUGHING
	2. SHARPEN TOOL IF NECESSARY
	3. MOUNT TOOL IN TOOL HOLDER
4. CLAPPER BOX	1. LOOSEN APRON CLAMP BOLTS
	2. SWIVEL CLAPPER BOX 20 DEGREES AWAY FROM SIDES OF STEPS TO BE CUT
	3. TIGHTEN APRON CLAMP BOLTS
	4. PLACE TOOL HOLDER IN CLAPPER BOX
	5. TIGHTEN TOOL HOLDER
	6. SET AT MIDDLE OF ADJUSTMENT

SKETCHES: DRAWING #5: STEP BLOCK

REFERENCES: REF. #1, PP. 37-1 TO 37-16
REF. #2, PP. 499-523

TASK SHEET

JOB: S-3
TASK: 3
PAGE: 1

TASK: MACHINE STEPS

JOB: MAKE STEP BLOCK

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, SHAPER VISE, TWO SHAPER TOOLS GROUND FOR RIGHT AND LEFT HAND CUTTING, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION TOOL FOR ROUGHING FIRST STEP	1. POSITION CUTTING TOOL AT END OF WORK 2. SET TOOL HEAD TO REMOVE 1/8" 3. SET FEED AT .020" PER CUT
2. ROUGH CUT FIRST STEP	1. PUT ON SAFETY GOGGLES 2. ENGAGE RAM CLUTCH 3. MACHINE ENTIRE SURFACE LEAVING 1/16" ON SHOULDER OF STEP 4. RETURN TOOL TO STARTING POSITION 5. SET MACHINE TO REMOVE ANOTHER 1/8" 6. MACHINE ENTIRE SURFACE LEAVING 1/16" ON SHOULDER OF STEP 7. REPEAT SAME PROCEDURE UNTIL THE FINAL ROUGH CUT HAS LEFT 1/16" ON BOTTOM OF STEP
3. ROUGH CUT SECOND STEP	REPEAT STEPS 1 AND 2 NOTE: BE AWARE THAT THE SHOULDER OF THE SECOND STEP IS CLOSER TO STARTING POINT THAN THE SHOULDER OF THE FIRST STEP
4. ROUGH CUT THIRD STEP	REPEAT STEPS 1 AND 2 NOTE: BE AWARE THAT THE SHOULDER OF THE THIRD STEP IS CLOSER TO STARTING POINT THAN THE SHOULDER OF THE SECOND STEP
5. ROUGH CUT FOURTH STEP	REPEAT STEPS 1 AND 2 NOTE: BE AWARE THAT THE SHOULDER IS ONLY 1 3/16" FROM END OF PART

6. CHECK TOOL	1. CUTTING TOOL MUST BE SHARP FOR FINISH 2. GRIND AND SET AT AN ANGLE TO CUT SQUARE SHOULDERS
7. SET MACHINE FOR FINISHING FIRST STEP VERTICAL	1. POSITION TOOL OVER WORK AND OVER SHOULDER ON FIRST STEP 2. ENGAGE RAM CLUTCH
8. MACHINE FIRST STEP VERTICAL TO FINISH	1. HAND FEED TABLE OVER AND TOOL HEAD DOWN UNTIL TOOL CUTS TO LAYOUT LINE ON TOP OF FIRST STEP 2. HAND FEED TOOL DOWN WITH THE TOOL HANDLE AT A RATE OF .010" PER CUT 3. CONTINUE FEEDING DOWN UNTIL TOOL POINT TOUCHES LAYOUT LINE ON BOTTOM OF FIRST STEP 4. STOP MACHINE NOTE: ALL VERTICAL FINISH CUTS ARE TO BE MADE BEFORE ANY HORIZONTAL FINISH CUTS
9. FINISH MACHINE SECOND STEP VERTICAL	REPEAT STEPS 7 AND 8 FOR SECOND STEP
10. FINISH MACHINE THIRD STEP VERTICAL	REPEAT STEPS 7 AND 8 FOR THIRD STEP
11. FINISH MACHINE FOURTH STEP VERTICAL	REPEAT STEPS 7 AND 8 FOR FOURTH STEP
12. FINISH MACHINE FIRST STEP HORIZONTAL	1. POSITION TOOL UNTIL IT IS OVER FIRST STEP AND NEAR THE OUTER END OF WORK 2. HAND FEED TOOL HEAD DOWN UNTIL TOOL CUTS TO LAYOUT LINE 3. DISENGAGE RAM CLUTCH WITH TOOL STOPPING AT THE FURTHERMOST BACK STROKE 4. MOVE TABLE TO SIDE UNTIL TOOL IS OFF END OF WORK 5. SET AUTOMATIC FEED AT .010" PER CUT
13. FINISH MACHINE FIRST STEP HORIZONTAL	1. ENGAGE RAM CLUTCH 2. START AUTOMATIC FEED

13.	FINISH MACHINE FIRST STEP HORIZONTAL (CON'T.)	3.	CUT UNTIL ALL THE SURFACE HAS BEEN CUT TO THE SHOULDER NOTE: STOP AUTOMATIC FEED ABOUT 1/16" BEFORE THE TOOL REACHES THE SHOULDER AND HAND FEED UNTIL THE TWO CUTS BLEND IN AT THE CORNER
14.	FINISH MACHINE SECOND STEP HORIZONTAL		REPEAT STEP 13
15.	FINISH MACHINE THIRD STEP HORIZONTAL		REPEAT STEP 13
16.	FINISH MACHINE FOURTH STEP HORIZONTAL	1.	REPEAT STEP 13
		2.	DISENGAGE RAM CLUTCH
		3.	STOP MACHINE MOTOR
		4.	REMOVE WORK FROM VISE
		5.	REMOVE AND STORE TOOL
17.	CLEAN MACHINE	1.	BRUSH MACHINE
		2.	WIPE MACHINE
		3.	DISPOSE OF CHIPS
18.	REMOVE BURRS	1.	MOUNT WORK PIECE IN BENCH VISE
		2.	PROTECT WORK
		3.	FILE MACHINE BURRS
19.	INSPECT		REFER TO VM-2-4

SKETCHES: DRAWING #5: STEP BLOCK

REFERENCES: REF. #1, PP. 37-1 TO 37-16
REF. #2, PP. 499-523

MACHINE SHOP STUD

ENGINE LATHE 1

BENCH 6

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWINGS, AND CONSTRUCT A STUD ACCORDING TO SPECIFICATIONS; USING THE VARIOUS MACHINES, TOOLS, AND EQUIPMENT CALLED FOR IN THE JOB.

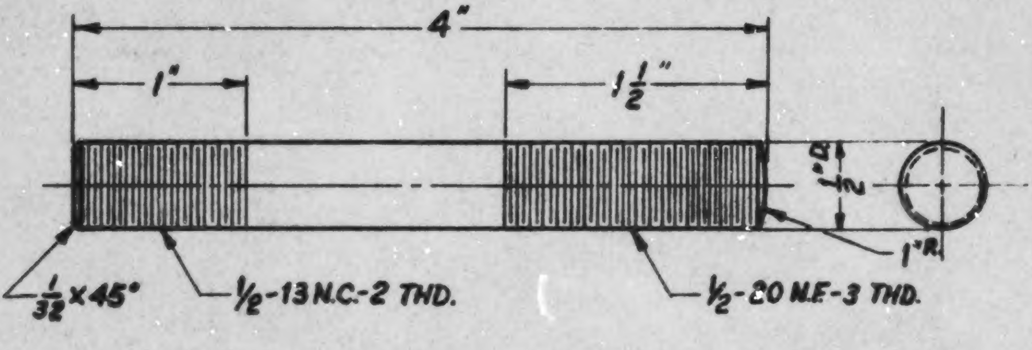
CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING NO. 6.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1, WALKER, JOHN R., *MODERN METALWORKING.*

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, *METALWORK TECHNOLOGY AND PRACTICE.*


4"
1"
1 1/2"
1/2" D
1" R.
1/32 × 45°
1/2-13 N.C.-2 THD.
1/2-20 N.F.-3 THD.

DRAWING NO. 6	STUD	TOLERANCE CHART
LATHE JOB NO. 1 BENCH JOB NO 5	MATERIAL: C.R. STEEL FINISH: FILE & POLISH SCALE: FULL SIZE	FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1/2°

JOB SHEET
IN
ENGINE LATHE

EL-1

JOB: MAKE STUD

MATERIALS: ONE PIECE 1/2" X 4 1/8" COLD ROLLED STEEL ROD

TOOLS AND EQUIPMENT: ENGINE LATHE, 1/2" COLLET AND COLLET EQUIPMENT, 3-JAW UNIVERSAL CHUCK, FACING TOOL GROUND FOR 1" R, COMBINATION SQUARE, SCRIBE, TOOL GROUND FOR 45 DEGREE CHAMFER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, PP. 36-1 TO 36-44 AND REF. #2, PP. 462-493. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

EL-1-1	CHECK LATHE FOR PROPER RUNNING CONDITION
EL-1-2a	MOUNT WORK IN COLLET CHUCK
EL-1-2b	MOUNT WORK IN UNIVERSAL CHUCK
EL-1-3	CUT 1" RADIUS
EL-1-4	FACE END
EL-1-5	CHAMFER END

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. SET LATHE PROPERLY FOR RADIUS.
2. SET LATHE PROPERLY FOR CHAMFER.
3. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: EL-1
TASK: 1
PAGE: 1

TASK: CHECK LATHE FOR PROPER RUNNING CONDITION
JOB: MAKE STUD
TRADE: MACHINIST
TOOLS AND MATERIALS: ENGINE LATHE. OIL

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LUBRICATION	1. OIL DAILY
	2. ONE OR TWO DROPS IN EACH OIL HOLE
	3. CLEAN AND OIL BED WAYS
	4. FILL OIL RESERVOIRS TO THE PROPER LEVEL NOTE: MOST MACHINES HAVE GLASS WINDOWS WITH CROSS MARK FOR PROPER LEVEL
2. CARRIAGE AND COMPOUND REST	1. LOOSEN CARRIAGE LOCK BOLT
	2. THE CARRIAGE AND COMPOUND REST SHOULD MOVE FREELY WHEN TURNED BY HAND WHEELS
	3. ADJUST COMPOUND REST FOR PROPER OVERHANG
3. GUARDS	1. ALL GUARDS IN POSITION
	2. TIGHTEN IF NECESSARY

SKETCHES: DRAWING #6: STUD

REFERENCES: REF. #1, P. 36-8
REF. #2, P. 465

TASK SHEET

JOB: EL-1
TASK: 2a
PAGE: 1

TASK: MOUNT WORK IN COLLET CHUCK
JOB: MAKE STUD
TRADE: MACHINIST
TOOLS AND MATERIALS: ENGINE LATHE, 1/2" COLLET AND COLLET EQUIPMENT, WORK PIECE
TASK BREAKDOWN:

STEPS	KEY POINTS
1. INSTALL 1/2" COLLET	1. WIPE THREADS CLEAN ON HEADSTOCK 2. SCREW NOSE CAP ON SPINDLE 3. INSERT COLLET SLEEVE IN SPINDLE 4. INSERT COLLET INTO SLEEVE 5. INSERT DRAW BAR THROUGH HEADSTOCK FROM LEFT END 6. HAND SCREW DRAW BAR ONTO COLLET NOTE: THERE ARE MANY TYPES OF COLLETS AND COLLET ATTACHMENTS. REF. #1, P. 36-22
2. MOUNT WORK	1. LOOSEN COLLET BY UNSCREWING THE DRAW BAR 2. PLACE STUD IN COLLET WITH 1/2" EXPOSED 3. HAND SCREW DRAW BAR ONTO COLLET 4. TIGHTEN DRAW BAR BY HAND NOTE: MACHINE MAY HAVE TO BE SET IN BACK GEAR TO PREVENT HEADSTOCK SPINDLE FROM TURNING

SKETCHES: DRAWING #6: STUD

REFERENCES: REF. #1, PP. 36-20 TO 36-24
REF. #2, PP. 471-474

TASK SHEET

OPTIONAL JOB: EL-1
TASK: 2b
PAGE: 1

TASK: MOUNT WORK IN UNIVERSAL CHUCK

JOB: MAKE STUD

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, 3-JAW UNIVERSAL CHUCK, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. INSTALL UNIVERSAL (3-JAW) CHUCK	1. CLEAN THREADS ON HEADSTOCK SPINDLE 2. SCREW CHUCK ONTO SPINDLE 3. TIGHTEN CHUCK
2. MOUNT WORK	1. PLACE STUD IN CHUCK WITH 1/2" EXPOSED 2. INSERT CHUCK WRENCH INTO TOP OF CHUCK 3. TIGHTEN JAWS ONTO STUD WITH THE CHUCK WRENCH NOTE: A 3-JAW CHUCK WILL NOT ORDINARILY RUN TRUE; THEREFORE, THE WORK PIECE WILL NOT RUN TRUE. BE CAUTIOUS OF THIS WHEN DOING SOME TYPES OF JOBS. A 3-JAW CHUCK WILL NOT HOLD WORK AS SECURE AS A 4-JAW CHUCK

SKETCHES: DRAWING #6: STUD

REFERENCES: REF. #1, P. 36-8
REF. #2, P. 465

TASK SHEET

JOB: EL-1
TASK: 3
PAGE: 1

TASK:	CUT 1" RADIUS
JOB:	MAKE STUD
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ENGINE LATHE, FACING TOOL GROUND FOR 1" RADIUS, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. INSTALL TOOL	1. SELECT 1" R. FACING TOOL 2. PLACE TOOL IN RIGHT HAND TOOL HOLDER 3. RADIUS END EXTENDED 1/2" 4. TIGHTEN TOOL IN POSITION, USE TOOL POST WRENCH
2. SET TOOL HOLDER	1. PLACE TOOL HOLDER IN TOOL POST 2. ADJUST TOOL POST TO POSITION, TOOL PARALLEL TO MACHINE WAYS 3. TIGHTEN TOOL HOLDER IN TOOL POST, USE TOOL POST WRENCH
3. SET MACHINE SPEED	SET AT 100 RPM NOTE: SEE SPEED AND FEED CHART REF. #1, P. 36-14 AND REF. #2, P. 550
4. POSITION TOOL	1. TURN THE COMPOUND REST HANDLE CLOCKWISE TO MOVE TOOL TOWARD HEADSTOCK 2. TURN CARRIAGE HANDLE COUNTER CLOCKWISE TO MOVE TOOL TOWARD HEADSTOCK 3. CENTER RADIUS TOOL DIRECTLY IN FRONT OF WORK
5. MACHINE RADIUS	1. PUT ON SAFETY GOGGLES 2. START MACHINE IN FORWARD MOTION 3. HAND FEED TOOL INTO WORK USING THE CARRIAGE HANDWHEEL 4. CONTINUE TO CUT TO THE MINIMUM

5. MACHINE RADIUS (CON'T.)		CLEAN-UP NOTE: IF CHATTER BEGINS IT WILL BE NECESSARY TO ENGAGE BACK GEARS
6. REMOVE BURRS	1.	FILE LIGHTLY WHILE MACHINE IS RUNNING
	2.	STOP MACHINE
	3.	LOOSEN HOLDING DEVICE, COLLET OR UNIVERSAL CHUCK
	4.	REMOVE WORK PIECE

SKETCHES: DRAWING #6: STUD

REFERENCES: REF. #1, PP. 36-8
REF. #2, P. 465

TASK SHEET

JOB: EL-1
TASK: 4
PAGE: 1

TASK: FACE END

JOB: MAKE STUD

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, STEEL RULE, SCRIBE, TOOL GROUND FOR 45 DEGREE CHAMFER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LAYOUT	SCRIBE LINE 4" FROM R. END
2. LOAD HOLDING DEVICE	1. MOUNT STUD IN HOLDING DEVICE AS BEFORE 2. LAID OUT END EXTENDING OUT ABOUT 1/2" 3. TIGHTEN HOLDING DEVICE AS BEFORE
3. INSTALL TOOL	1. REMOVE RADIUS TOOL 2. SELECT TOOL GROUND FOR 45 DEGREE CHAMFER 3. INSERT TOOL IN TOOL HOLDER WITH CUTTING END EXTENDING OUT ABOUT 1/2" FROM END OF TOOL HOLDER 4. TIGHTEN TOOL, USE THE TOOL POST WRENCH 5. LOOSEN TOOL HOLDER AND TOOL POST WITH TOOL POST WRENCH 6. ADJUST TOOL TO POSITION FOR FACING 7. TIGHTEN TOOL HOLDER
4. SET RPM	1. DISENGAGE BACK GEAR 2. SET MACHINE AT 600 RPM
5. POSITION TOOL	1. MOVE CARRIAGE AND COMPOUND REST 2. POSITION TOOL AT END OF WORK PIECE 3. READJUST CUTTING TOOL HOLDER UNTIL POINT OF THE TOOL WILL PASS THROUGH THE EXACT CENTER LINE OF WORK 4. SET TOOL POST ON LEFT SIDE OF COMPOUND REST TO PREVENT COMPOUND REST FROM HITTING LATHE CHUCK

5. POSITION TOOL (CON'T.)	5. SET MACHINE TO CROSS FEED AUTOMATICALLY 6. SET FEED REVERSE LEVER IN FORWARD NOTE: THIS SETS THE DIRECTION. LEAD SCREW WILL REVOLVE, HOWEVER IT WILL NOT START UNTIL MACHINE IS STARTED
6. FACE END	1. PUT ON GOGGLES 2. START MACHINE 3. MOVE COMPOUND REST TO LEFT 4. REMOVE ABOUT 1/2 OF THE MATERIAL FROM END OF STUD TO LAYOUT LINE ON STUD 5. ENGAGE FEED LEVER NOTE: WHEN TOOL HAS FACED TO CENTER OF STUD DISENGAGE FEED LEVER 6. TURN COMPOUND REST HANDLE COUNTERCLOCKWISE TO RETURN TOOL TO STARTING POSITION 7. FINISH FACE END OF STUD TO LAYOUT LINE NOTE: IF A LARGE CUT WERE TO BE TAKEN ON FACING IT WOULD BE NECESSARY TO LOCK CARRIAGE IN POSITION PRIOR TO EACH CUT 8. STOP MACHINE

SKETCHES: DRAWING #6: STUD

REFERENCES: REF. #1, PP. 36-1 TO 36-44
REF. #2, PP. 462-464

TASK SHEET

JOB: EL-1
TASK: 5
PAGE: 1

TASK: CHAMFER END

JOB: MAKE STUD

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, TOOL GROUND FOR 45 DEGREE CHAMFER, WORK PIECE, 10" MILL FILE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. ADJUST TOOL FOR CHAMFER	1. LOOSEN TOOL POST
	2. POSITION TOOL PERPENDICULAR TO WORK
	3. TIGHTEN TOOL POST
	4. MOVE CARRIAGE AND COMPOUND REST UNTIL CHAMFERING TOOL IS NEAR END OF WORK
	5. MOVE CARRIAGE AND COMPOUND REST UNTIL 45 DEGREE ANGLE ON TOOL IS CENTERED AT CORNER OF WORK
2. CHAMFER	1. PUT ON GOGGLES
	2. START MACHINE
	3. MOVE COMPOUND REST IN BY TURNING HANDLE CLOCKWISE UNTIL TOOL BEGINS TO CUT
	4. SET COMPOUND REST DIAL ON "0" AND TIGHTEN
	5. FEED TOOL INTO WORK .030" ACCORDING TO THE DIAL BY TURNING THE HANDLE ON COMPOUND REST CLOCKWISE
	6. MOVE CARRIAGE AWAY FROM WORK BY TURNING THE CARRIAGE HANDWHEEL CLOCKWISE
3. REMOVE BURRS	1. LAY FILE ON EDGES OF ROTATING WORK
	2. FILE VERY LIGHTLY
	3. STOP MACHINE
	4. REMOVE WORK PIECE

4. CLEAN MACHINE
    1. REMOVE CHIPS WITH BRUSH
    2. WIPE MACHINE WITH RAG
    3. DISPOSE OF WASTE

ROUTE WORK TO BENCH

SKETCHES: DRAWING #6: STUD

REFERENCES: REF. #1, PP. 36-1 TO 36-44
REF. #2, PP. 462-464

JOB SHEET
IN
BENCH WORK

JOB:	MAKE STUD	
MATERIALS:	WORK PIECE 1/2" X 4" COLD ROLLED STEEL ROD WITH 1" RADIUS ON ONE END AND 45 DEGREE CHAMFER ON OTHER END	
TOOLS AND EQUIPMENT:	COMBINATION SQUARE, SCRIBE, BENCH VISE, COPPER VISE JAWS, DIESTOCK, 1/2"-13 N. C. DIE, 1/2"-20 N. F. DIE, CUTTING OIL IN CAN, 10" MILL FILE	
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #1, PP. 11-5 TO 11-8 AND REF. #2, PP. 240-243	
PROCEDURES AND/OR TASKS:	B-6-1	LAYOUT ENDS
	B-6-2	HAND THREAD 1/2"-13 N. C. 2
	B-6-3	HAND THREAD 1/2"-20 N. F. 3
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.	

1. DIE SET TO ROUGH THREADS.
2. DIE SET TO FINISH THREADS.
3. CHECK THREADS WITH NUT.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: B-6
TASK: 1
PAGE: 1

TASK:	LAYOUT ENDS
JOB:	MAKE STUD
TRADE:	MACHINIST
TOOLS AND MATERIALS:	COMBINATION SQUARE SCRIBE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SCRIBE CHAMFERED END	1. SET COMBINATION SQUARE ON 1" 2. SCRIBE LINE AROUND STUD 1" FROM CHAMFERED END
2. SCRIBE RADIUS END	1. SET COMBINATION SQUARE ON 1 1/2" 2. SCRIBE LINE AROUND STUD 1 1/2" FROM RADIUS END

SKETCHES: DRAWING #6: STUD

REFERENCES: REF. #1, PP. 6-1 TO 6-10
REF. #2, PP. 62-66

TASK SHEET

JOB: B-6
TASK: 2
PAGE: 1

TASK: HAND THREAD 1/2"-13N. C. 2

JOB: MAKE STUD

TRADE: MACHINIST

TOOLS AND EQUIPMENT: BENCH VISE, COPPER VISE JAWS, 1/2"-13N. C. DIE, DIE STOCK, WORK PIECE, CUTTING OIL IN CAN

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK	1. OPEN VISE 3/4" 2. POSITION STUD a. PERPENDICULAR TO TABLE b. CHAMFER END UP c. 1 1/2" EXTENDING ABOVE THE VISE JAWS NOTE: PROTECT WORK WITH COPPER 3. TIGHTEN VISE
2. INSTALL DIE	1. SELECT 1/2"-13 N. C. DIE 2. ADJUST DIE POINTS TO CUT OVERSIZE 3. INSERT DIE IN DIE STOCK WITH THE STARTER THREADS AWAY FROM THE SHOULDER OF STOCK 4. TIGHTEN DIE IN DIE STOCK
3. ROUGH HAND THREAD	1. PLACE DIE OVER END OF THE STUD STARTER THREADS DOWN 2. GRASP DIE STOCK WITH BOTH HANDS NEAR WORK 3. PRESS DOWN FIRMLY 4. TURN DIE STOCK CLOCKWISE 5. OIL DIE THOROUGHLY AFTER EACH TWO ROUNDS 6. BACK UP THE DIE EVERY 1/4 REVOLUTIONS TO CLEAN AND BREAK AWAY CHIPS 7. CONTINUE TO LAYOUT LINE 8. REMOVE DIE FROM STUD 9. WIPE DIE AND STUD CLEAN

4. ADJUST AND INSTALL DIE FOR FINISH THREAD	1. ADJUST DIE POINTS TO FINISH SIZE 2. INSERT DIE IN DIE STOCK 3. TIGHTEN
5. FINISH HAND THREAD	1. REPEAT STEP 3 2. CHECK THREADS WITH NUT OR THREAD GAUGE NOTE: A GOOD FIT REQUIRES THE NUT TO MOVE FREELY BUT WITHOUT PLAY 3. READJUST AND MAKE ANOTHER FINISH CUT IF NECESSARY 4. REMOVE DIE FROM STUD 5. WIPE DIE AND STUD CLEAN 6. REMOVE WORK FROM VISE

SKETCHES: DRAWING #6: STUD

REFERENCES: REF. #1, PP. 11-5 TO 11-8
REF. #2, PP. 240-243

TASK SHEET

JOB: B-6
TASK: 3
PAGE: 1

TASK: HAND THREAD 1/2"-20 N. F. 3
JOB: MAKE STUD
TRADE: MACHINIST
TOOLS AND MATERIALS: BENCH VISE, COPPER VISE JAWS, 1/2"-20 N. F. DIE, DIE STOCK, CUTTING OIL IN CAN, 10" MILL FILE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK	1. OPEN VISE 3/4" 2. POSITION STUD a. PERPENDICULAR TO TABLE b. RADIUS END UP c. 1 3/4" EXTENDING ABOVE THE VISE JAWS 3. PROTECT WORK 4. TIGHTEN VISE
2. INSTALL DIE	1. SELECT 1/2"-20 N. F. 3 2. REPEAT STEP 2, TASK 2
3. ROUGH HAND THREAD	REPEAT STEP 3, TASK 2
4. ADJUST AND INSTALL DIE FOR FINISH THREAD	REPEAT STEP 4, TASK 2
5. FINISH HAND THREAD	REPEAT STEP 5, TASK 2
6. REMOVE BURRS	FILE THREADS VERY LIGHTLY
7. INSPECT WORK	
A. SIZE OF STUD	1/2" X 4"
B. CHAMFER END	1. 1/32" X 45^0 CHAMFER 2. 1/2"-13 N. C. THREADS 3. 1" THREADED
C. RADIUS END	1. 1" RADIUS 2. 1/2"-20 N. F. THREADS 3. 1 1/2" THREADED

SKETCHES: DRAWING #6: STUD
REFERENCES: REF. #1, PP. 11-5 TO 11-8
REF. #2, PP. 240-243

MACHINE SHOP PARALLEL BLOCKS

BENCH WORK	7
POWER HACKSAW	5
SHAPER	4
MILLING	3
SURFACE GRINDER	1
HEAT TREAT	1

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND CONSTRUCT PARALLEL BLOCKS ACCORDING TO SPECIFICATIONS; USING THE VARIOUS MACHINES AND PROCESSES CALLED FOR IN THE JOB.

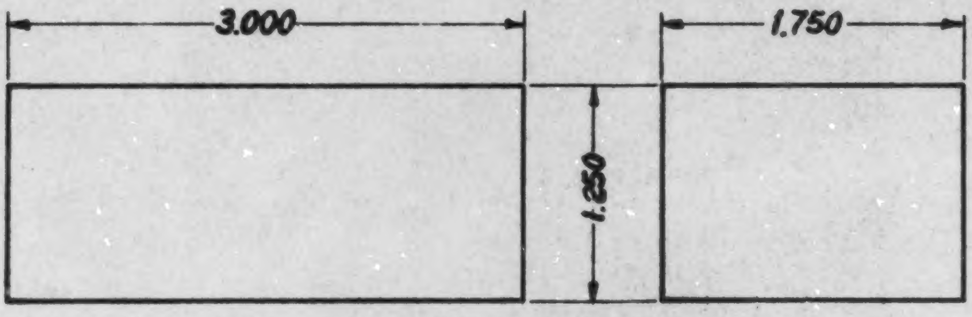
CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINES FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. 1, WALKER, JOHN R., MODERN METALWORKING.

REF. 2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.



NOTE: ALLOW .016 FOR GRINDING
CARBURIZE & HARDEN
GRIND ALL OVER

DRAWING NO. 7	PARALLEL BLOCKS	TOLERANCE CHART
MILLING JOB NO. 3 SHAPER JOB NO. 4 SURFACE GRINDER JOB NO. 1 BENCH JOB NO. 6	MATERIAL : C.R. STEEL FINISH : GRIND & LAP SCALE : FULL SIZE	FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1/2°

S-4

JOB SHEET
IN
SHAPER

JOB: MAKE TWO PARALLEL BLOCKS

MATERIALS: ONE PIECE 1 1/2" X 2" X 6 1/4" COLD ROLLED STEEL

TOOLS AND EQUIPMENT: SHAPER, SHAPER VISE, SHAPER TOOL HOLDER, TOOL BIT, SURFACE GAUGE, 2" AND 3" MICROMETERS, COMBINATION SQUARE, 10" FLAT MILL FILE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, "PLANING MACHINES", PP. 37-1 TO 37-16 AND REF. #2, "THE SHAPER OPERATIONS", PP. 499-523. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

S-4-1	CHECK SHAPER FOR PROPER RUNNING CONDITIONS. DRILL DRIFT, S-1-1
S-4-2	SET UP SHAPER. DRILL DRIFT, S-1-2
S-4-3	FACE EDGES AND SIDES. STEP BLOCK, S-3a-3
S-4-4	ROUTE TO POWER HACKSAW. CLAMP STRAP, PH-1
S-4-5	MACHINE ENDS

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. PROPER MACHINE SETUP.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. SMOOTH MACHINE FINISH.
4. ALL SURFACES SQUARE AND PARALLEL TO EACH OTHER.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: S-4
TASK: 5
PAGE: 1

TASK: MACHINE ENDS
JOB: MAKE PARALLEL BLOCKS
TRADE: MACHINIST
TOOLS AND MATERIALS: SHAPER, COMBINATION SQUARE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK IN VISE	1. OPEN VISE 2. PLACE WORK IN VISE WITH ONE END UP 3. CHECK EDGES WITH SQUARE 4. TIGHTEN VISE
2. MACHINE ONE END OF FIRST BLOCK	1. REFER TO S-3a-3 2. MACHINE 1/8" OFF END
3. MACHINE ONE END OF SECOND BLOCK	REPEAT STEP 2
4. MACHINE SECOND END OF EACH BLOCK	1. REPEAT STEP 1 2. HOLD TO 3.015" TO ALLOW FOR GRINDING
5. CLEAN MACHINE	1. BRUSH 2. WIPE 3. DISPOSE OF WORK
6. REMOVE BURRS	1. MOUNT IN BENCH VISE 2. FILE

ROUTE TO HEAT TREAT

SKETCHES: DRAWING #7: PARALLEL BLOCKS

REFERENCES: REF. #1, PP. 37-1 TO 37-16
REF. #2, PP. 499-523

JOB SHEET
IN
MILLING

JOB: MAKE TWO PARALLEL BLOCKS

MATERIALS: WORK PIECE 1 1/2" X 2" X 6 1/4" COLD ROLLED STEEL

TOOLS AND EQUIPMENT: HORIZONTAL MILLING MACHINE, MILLING MACHINE VISE, HELICAL SLAB MILL 3" D. X 2" W. X 1" HOLE, 1" ARBOR AND COLLARS, COMBINATION SQUARE, 2" AND 3" MICROMETERS

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 38-1 TO 38-37 AND REF. #2, PP. 524-564 CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

HM-3-1	CHECK MACHINE FOR PROPER RUNNING CONDITION. T-NUT, HM-1-1
HM-3-2	MOUNT WORK IN HORIZONTAL MILL VISE. STEP BLOCK, HM-2-2
HM-3-3	SET UP MACHINE FOR MILLING. STEP BLOCK, HM-2-3
HM-3-4	MILL SIDES AND EDGES TO $1.265^{+.010}_{-.004}$ AND $1.765^{+.010}_{-.003}$ STEP BLOCK HM-2-4
HM-3-5	ROUTE TO POWER HACKSAW. CLAMP STRAP, PH-1
HM-3-6	MILL ENDS TO $3.015^{+.010}_{-.003}$ LENGTH. STEP BLOCK, HM-2-4

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. PROPER MACHINE SETUP.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. SMOOTH MACHINE FINISH.
4. ALL SURFACES SQUARE AND PARALLEL TO EACH OTHER.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

HT-1

JOB SHEET
IN
HEAT TREATING

JOB: MAKE TWO PARALLEL BLOCKS

MATERIALS: TWO MILD STEEL BLOCKS MACHINED AND READY FOR CARBURIZING

TOOLS AND EQUIPMENT: BLAST FURNACE, KASENITE, QUENCHING SOLUTION, 10" MILL FILE, SAFETY EQUIPMENT

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, PP. 31-1 TO 31-9. CHECK WITH INSTRUCTOR AT FREQUENT INTERVALS.

PROCEDURES AND/OR TASKS:

HT-1-1	PREPARE FURNACE FOR PROPER HEAT TREATING
HT-1-2	PREPARE BLOCKS
HT-1-3	CASE HARDEN BLOCKS
HT-1-4	TEST WORK

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. PROPER FURNACE SETTING.
2. PROPER AIR FLOW.
3. EXHAUST SYSTEM.
4. PROPER TEMPERATURE.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: HT-1
TASK: 1
PAGE: 1

TASK:	PREPARE FURNACE
JOB:	MAKE TWO PARALLEL BLOCKS
TRADE:	MACHINIST
TOOLS AND MATERIALS:	BLAST FURNACE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHECK FURNACE	1. FURNACE EMPTY
	2. PROPER GAS FLOW
	3. PROPER AIR FLOW
	4. EXHAUST SYSTEM FUNCTIONAL
2. CHECK SURROUNDING AREA	1. NO FLAMMABLE LIQUIDS IN AREA
	2. PROPER FIRE EXTINGUISHER READILY AVAILABLE
	3. STUDENT SAFETY EQUIPMENT NEAR

SKETCHES: DRAWING #7: PARALLEL BLOCKS

REFERENCES: REF. #1, PP. 31-1 TO 31-8

TASK SHEET

JOB: HT-1
TASK: 2
PAGE: 1

TASK: PREPARE BLOCKS

JOB: MAKE TWO PARALLEL BLOCKS

TRADE: MACHINIST

TOOLS AND MATERIALS: KASENITE, CONTAINER FOR BLOCKS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CLEAN BLOCKS	1. WASH WITH SOAP AND WATER 2. DRY THOROUGHLY
2. KASENITE	1. SELECT CONTAINER LARGE ENOUGH TO CONTAIN BOTH BLOCKS NOTE: CONTAINER TOO LARGE WILL RESULT IN WASTE OF KASENITE 2. PLACE BLOCKS FLAT IN CONTAINER 3. COVER BLOCKS WITH KASENITE OR OTHER CARBURIZING COMPOUND 4. USE VENTED COVER IF DESIRED

SKETCHES: DRAWING #7: PARALLEL BLOCKS

REFERENCES: REF. #1, PP. 30-1 TO 30-9

TASK SHEET

JOB: HT-1
TASK: 3
PAGE: 1

TASK: CASE HARDEN BLOCKS

JOB: MAKE TWO PARALLEL BLOCKS

TRADE: MACHINIST

TOOLS AND MATERIALS: BLAST FURNACE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. PREPARE TO LIGHT FURNACE	1. PUT ON LEATHER APRON
	2. PUT ON GOGGLES OR FACE SHIELD
2. LIGHT FURNACE	1. ROLL UP A 12" LONG PIECE OF PAPER
	2. LIGHT ONE END OF PAPER WITH MATCH
	3. PUT LIGHTED PAPER IN FURNACE
	4. TURN AIR ON FIRST
	5. TURN GAS ON (MEDIUM)
3. HARDEN MATERIAL	1. USE LONG DRY TONGS TO PICK UP CONTAINER WITH WORK PIECES
	2. GENTLY PLACE CONTAINER IN FURNACE
	3. HEAT FURNACE TO 1650 DEGREES F.
	4. SOAK PARTS FOR 1 TO 1 1/2 HOURS NOTE: A HARDENED SURFACE OF .020" TO .030" WILL BE PRODUCED, .015" TO BE GROUND AWAY IN FINISHING
	5. REMOVE PARTS FROM MOLTEN COMPOUND WITH DRY TONGS
	6. QUENCH IN CLEAN WATER IMMEDIATELY
4. CLEAN UP	1. TURN OFF GAS
	2. TURN OFF AIR
	3. LEAVE EXHAUST FAN ON FOR FIFTEEN MINUTES THEN TURN OFF
	4. DISPOSE OF KASENITE SOLUTION CAUTION: BE VERY CAREFUL NOT TO SPLATTER
	5. RETURN SAFETY EQUIPMENT TO PROPER PLACE

5. TEST WORK	1. PLACE EDGE OF FILE ON EDGE OF BLOCK 2. MAKE ONE STROKE WITH FILE NOTE: IF PART IS HARDENED PROPERLY THE FILE WILL NOT CUT. IF IT DOES CUT, THE PROCESS MUST BE REPEATED USING A HIGHER TEMPERATURE

ROUTE TO SURFACE GRINDER

SKETCHES: DRAWING #7: PARALLEL BLOCKS

REFERENCES: REF. #1, PP. 30-1 TO 30-9

SG-1

JOB SHEET
IN
SURFACE GRINDER

JOB:	MAKE TWO PARALLEL BLOCKS
MATERIALS:	TWO MILD STEEL BLOCKS CARBURIZED AND HARDENED
TOOLS AND EQUIPMENT:	SURFACE GRINDER, MAGNETIC CHUCK, PRECISION GROUND ANGLE PLATE, 3" "C" CLAMP, GRINDING WHEEL, DIAMOND WHEEL DRESSER, 2" AND 3" MICROMETERS, TOOLMAKER'S SOLID SQUARE, DEPTH MICROMETERS (2"-3"), BRASS HAMMER, HONE
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #1, PP. 33-1 TO 33-15 AND REF. #2, PP. 565-581. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.
PROCEDURES AND/OR TASKS:	SG-1-1 CHECK MACHINE FOR PROPER RUNNING CONDITION SG-1-2 SET UP MACHINE FOR GRINDING SG-1-3 GRIND WORK PIECES
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK. 1. ELECTROMAGNET HOLDING POWER. 2. CORRECT SETUP. 3. GRINDING WHEEL SHARP AND FREE OF CRACKS OR FLAWS. 4. ALL DIMENSIONS HELD TO SPECIFICATIONS. 5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: SG-1
TASK: 1
PAGE: 1

TASK:	CHECK MACHINE FOR PROPER RUNNING CONDITION
JOB:	MAKE TWO PARALLEL BLOCKS
TRADE:	MACHINIST
TOOLS AND MATERIALS:	SURFACE GRINDER, OIL AND OIL CAN

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LUBRICATE MACHINE	1. PLACE ONE OR TWO DROPS OF OIL IN EACH OIL CAP 2. WIPE DUST FROM WAYS 3. OIL WAYS LIGHTLY
2. CHECK COOLANT	1. CHECK LEVEL OF COOLANT TANK 2. FILL TANK IF NECESSARY
3. CHECK CHUCK POWER	1. LAY WORK PIECE ON CHUCK 2. TURN MAGNETIC CHUCK ON 3. ATTEMPT TO TWIST WORK PIECE NOTE: IF POWER IS ON WORK PIECE WILL BE DIFFICULT TO TURN 4. TURN POWER OFF 5. REMOVE WORK PIECE
4. CHECK GUARDS	1. ALL GUARDS IN PLACE 2. SOME MACHINES REQUIRE DUST GUARD IN FRONT OF GRINDING WHEEL

SKETCHES: DRAWING #7: PARALLEL BLOCKS

REFERENCES: REF. #1, PP. 33-1 TO 33-14
REF. #2, PP. 565-581

TASK SHEET

JOB: SG-1
TASK: 2
PAGE: 1

TASK: SET UP MACHINE FOR GRINDING

JOB: MAKE TWO PARALLEL BLOCKS

TRADE: MACHINIST

TOOLS AND MATERIALS: SURFACE GRINDER, MAGNETIC CHUCK, GRINDING WHEEL, DIAMOND WHEEL DRESSER, BRASS HAMMER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT MAGNETIC CHUCK	1. WIPE TABLE CLEAN OF DUST 2. WIPE BOTTOM OF MAGNETIC CHUCK 3. PLACE CHUCK ON TABLE 4. INSERT T-BOLTS IN KEY SLOTS IN TABLE 5. BLOT MAGNETIC CHUCK TO TABLE 6. TIGHTEN BOLTS NOTE: ON MOST GRINDERS THE CHUCK IS EITHER PERMANENTLY ATTACHED OR A PART OF THE MACHINE. REF. #2, P. 576
2. CHECK SURFACE OF CHUCK	1. MOUNT DIAL INDICATOR SOMEWHERE ON HORIZONTAL ARM OF GRINDER NOTE: NOT TO BE MOUNTED ON THE GRINDING WHEEL 2. POSITION INDICATOR OVER CHUCK 3. LOWER GRINDING HEAD UNTIL INDICATOR READS .020" 4. MOVE TABLE FEED IN AND OUT TO INDICATE ACROSS CHUCK 5. TURN TABLE TRAVEL TO INDICATE LENGTH OF CHUCK NOTE: CHUCK MUST INDICATE TRUE AND MAY REQUIRE A LIGHT CUT SURFACE GROUND OF FACE
3. MOUNT GRINDING WHEEL	1. REMOVE NUT ON END OF SPINDLE NOTE: A SPANNER WRENCH MAY BE PROVIDED 2. SLIDE GRINDING WHEEL ONTO SPINDLE

3. MOUNT GRINDING WHEEL (CON'T.)	3. PLACE HEAVY PAPER WASHER ON EACH SIDE OF WHEEL 4. REPLACE NUT ON SPINDLE 5. TIGHTEN NUT NOTE: TIGHTENING TOO TIGHT MAY CRACK THE WHEEL
4. TEST GRINDING WHEEL	1. USE METAL HAMMER 2. LIGHTLY TAP THE SIDE OF GRINDING WHEEL NOTE: WHEEL WILL RING IF NOT CRACKED, IF CRACKED IT WILL PRODUCE A DULL OR DEAD SOUND 3. CHECK BY TAPPING IN SEVERAL DIFFERENT PLACES
5. DRESS GRINDING WHEEL	1. MOUNT DIAMOND DRESSER POINT UP IN HOLDER 2. TIGHTEN SET SCREW ON DIAMOND TO HOLD IT TIGHT IN HOLDER 3. SET THE DIAMOND HOLDER ON CHUCK WITH DIAMOND POINT UP 4. TURN ELECTROMAGNETIC CHUCK ON 5. MOVE TABLE HANDLES TO POSITION DIAMOND UNDER CENTER OF GRINDING WHEEL 6. LOWER GRINDING WHEEL TO 1/16" ABOVE WORK 7. REVOLVE WHEEL BY HAND TO BE SURE WHEEL DOES NOT TOUCH DIAMOND 8. PUT SAFETY GOGGLES ON 9. TURN SPINDLE ON NOTE: STAND TO ONE SIDE OF WHEEL. ALLOW WHEEL TO RUN ABOUT 30 SECONDS. IF WHEEL IS FAULTY IT WILL FLY APART NOW 10. LOWER WHEEL UNTIL IT TOUCHES DIAMOND 11. MOVE TABLE CROSS FEED UNTIL DIAMOND IS CLEAR OF WHEEL 12. LOWER WHEEL .005" WITH THE DIAL ON FINE WHEEL ADJUSTMENT 13. MOVE TABLE CROSS FEED UNTIL DIAMOND CLEARS OPPOSITE SIDE OF THE WHEEL

5. DRESS GRINDING WHEEL (CON'T.)	14. CONTINUE TAKING .005" PER CUT UNTIL WHEEL DRESSES SMOOTH ALL THE WAY AROUND
	15. STOP SPINDLE
6. CLEAN CHUCK	1. TURN POWER OFF ON THE MAGNETIC CHUCK
	2. REMOVE DIAMOND HOLDER
	3. REMOVE DIAMOND FROM THE DIAMOND HOLDER
	4. REPLACE DIAMOND AND HOLDER TO THEIR RESPECTIVE PLACES
	5. WIPE CHUCK CLEAN WITH RAG
	6. WIPE CHUCK CLEAN WITH BARE HAND NOTE: THE RAG WILL NOT GET ALL THE DUST OFF CHUCK

SKETCHES: DRAWING #7: PARALLEL BLOCKS

REFERENCES: REF. #1, PP. 33-1 TO 33-14
REF. #2, PP. 565-581

TASK SHEET

JOB: SG-1
TASK: 3
PAGE: 1

TASK: GRIND WORK PIECES

JOB: MAKE TWO PARALLEL BLOCKS

TRADE: MACHINIST

TOOLS AND MATERIALS: SURFACE GRINDER, TOOLMAKER'S SOLID SQUARE, 2" AND 3" DEPTH MICROMETERS, 3" "C" CLAMP, BRASS HAMMER, PRECISION GROUND ANGLE PLATE, HONE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. GRIND ONE SIDE BOTH BLOCKS	1. WIPE ONE SIDE OF EACH BLOCK WITH BARE HAND 2. PLACE BLOCKS ON CHUCK END TO END 3. TURN THE ELECTROMAGNETIC CHUCK POWER ON 4. LOWER GRINDING WHEEL TO WITHIN 1/16" OF WORK NOTE: IF ONE BLOCK IS THICKER, CENTER WHEEL OVER THE THICKEST BLOCK 5. PUT SAFETY GOGGLES ON 6. TURN SPINDLE ON 7. TURN COOLANT ON IF USING A GRINDER 8. USING THE CROSS FEED HANDWHEEL, FEED WORK PIECE OUTWARD UNTIL THE WHEEL EXTENDS BEYOND WORK A DISTANCE EQUAL TO 3/4" THE WIDTH OF THE WHEEL FACE 9. USE THE ELEVATING HANDWHEEL TO LOWER WHEEL UNTIL IT BEGINS TO CUT 10. USE TABLE HAND CRANK OR HAND-FEED TABLE LONGITUDINALLY UNDER THE WHEEL AT A STEADY RATE UNTIL WORK HAS PASSED 1" BEYOND THE GRINDING WHEEL ON EACH END 11. USE TABLE CROSSFEED HANDWHEEL TO FEED WORK CROSSWISE ONE COMPLETE TURN EACH TIME CUT HAS

1. GRIND ONE SIDE BOTH BLOCKS (CON'T.)
    - BEEN COMPLETED LONGITUDINALLY
    12. AFTER ENTIRE SURFACE HAS BEEN COVERED, LOWER GRINDING WHEEL FROM .002" TO .003" FOR THE NEXT CUT
    13. REPEAT THE ABOVE THREE PROCEDURES UNTIL BOTH BLOCKS ARE 100% CLEANED UP WITH GRINDING WHEEL
    14. STOP MACHINE
    15. TURN POWER OFF ON CHUCK
    16. REMOVE WORK PIECES
    17. WIPE CHUCK CLEAN WITH RAG
    18. WIPE CHUCK CLEAN WITH HAND
    19. WIPE BOTH BLOCKS CLEAN WITH RAG
    20. WIPE GROUND SURFACES CLEAN WITH HAND
    21. LAY GROUND SURFACE OF BLOCKS ON CHUCK, END TO END AS BEFORE
    22. TURN CHUCK POWER ON

2. GRIND SECOND SIDES
    1. REPEAT STEP 1
    2. HOLD THICKNESS 1.251 ±.0005, THIS ALLOWS .001" FOR LAPPING
       NOTE: CHECK THICKNESS WITH 1"-2" DEPTH MICROMETER TO AVOID REMOVING WORK UNTIL COMPLETED
    3. STOP MACHINE
    4. TURN POWER OFF ON CHUCK
    5. REMOVE WORK PIECES

3. GRIND ONE EDGE OF FIRST BLOCK
    1. WIPE CHUCK CLEAN AS IN STEP 1
    2. WIPE BOTH SIDES OF ANGLE PLATE CLEAN WITH RAG
    3. WIPE BOTH SIDES OF ANGLE PLATE CLEAN WITH HAND
    4. PLACE ANGLE PLATE ON MAGNETIC CHUCK, WITH FACE OF ANGLE PLATE TOWARD OPERATOR
    5. TURN CHUCK POWER ON
    6. PLACE THE GROUND SURFACE OF ONE BLOCK AGAINST ANGLE PLATE AND PARALLEL TO TABLE
       NOTE: BE SURE TOP SURFACE OF THE WORK PIECE IS 1/4" ABOVE TOP OF ANGLE PLATE

3. GRIND ONE EDGE OF FIRST BLOCK (CON'T.)	7. CLAMP WORK PIECE TO ANGLE PLATE 8. USE "C" CLAMP NOTE: CHECK TO SEE THAT CLAMP DOES NOT EXTEND ABOVE SURFACE OF WORK PIECE 9. MOUNT INDICATOR ON HORIZONTAL HEAD 10. INDICATE TOP OF WORK PIECE TRUE NOTE: TAP THE WORK PIECE GENTLY WITH BRASS HAMMER TO GET IT TRUE 11. REPEAT SAME GRINDING PROCEDURE TO CLEAN UP EDGE 12. STOP MACHINE 13. REMOVE WORK PIECE
4. GRIND FIRST EDGE OF SECOND BLOCK	REPEAT STEP 2
5. GRIND SECOND EDGE OF BOTH BLOCKS	1. REMOVE ANGLE PLATE FROM CHUCK 2. CLEAN CHUCK WITH RAG AND HAND 3. CLEAN BOTH WORK PIECES WITH RAG AND HAND 4. MOUNT BOTH WORK PIECES, GROUND EDGE ON CHUCK, END TO END 5. TURN CHUCK POWER ON 6. REPEAT NOTE: HOLD WIDTH 1.765 ±.0005, THIS IS .001" OVERSIZE TO ALLOW FOR LAPPING 7. STOP MACHINE 8. TURN POWER OFF 9. REMOVE WORK PIECES
6. GRIND ONE END OF FIRST BLOCK	1. CLEAN CHUCK 2. CLEAN ANGLE PLATE 3. PLACE ANGLE PLATE ON CHUCK WITH FACE TOWARD OPERATOR 4. TURN POWER ON CHUCK 5. CLAMP ONE BLOCK TO ANGLE PLATE WITH ONE END UP 6. PLACE SQUARE AGAINST GROUND EDGE TO GET WORK PERPENDICULAR 7. GRIND TO A MINIMUM CLEAN UP
7. GRIND FIRST END OF SECOND BLOCK	1. REPEAT STEP 5 2. REMOVE ANGLE PLATE FROM TABLE

8. GRIND SECOND END OF BOTH BLOCKS
    1. SET UP AS IN STEP 5
    2. CLAMP BOTH BLOCKS
    3. GRIND AS IN STEP 5
    4. HOLD TO 3.001 ±.0005
    5. TURN POWER OFF

9. CLEAN UP
    1. REMOVE BLOCKS
    2. CLEAN AND RETURN EQUIPMENT TO PROPER PLACE
    3. CLEAN MACHINE THOROUGHLY
       NOTE: AIR IS NOT TO BE USED AS IT WILL BLOW PARTICLES OF ROCK AND GRINDING DUST INTO MACHINE WAYS

10. REMOVE BURRS
    1. RUB ALL EDGES WITH A HONE
       NOTE: MATERIAL IS HARD AND FILING WILL RESULT IN DULLING A FILE

ROUTE TO BENCH

SKETCHES: DRAWING #7: PARALLEL BLOCKS

REFERENCES: REF. #1, PP. 33-1 TO 33-15
REF. #2, PP. 565-581

B-7

JOB SHEET
IN
BENCH WORK

JOB: MAKE TWO PARALLEL BLOCKS

MATERIALS: TWO HARDENED AND GROUND PARALLEL BLOCKS LEFT .001" OVERSIZE FOR LAPPING

TOOLS AND EQUIPMENT: LAPPING PLATE, GAUGE BLOCKS, LAST WORD INDICATOR, KEROSENE OR NAPHTHA, FINE LAPPING COMPOUND, OIL CAN

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #2, PP. 127 AND 451. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

B-7a-1	PREPARE LAPPING PLATE
B-7a-2	LAP BLOCKS
B-7a-3	CHECK WORK

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. PROPER LAPPING COMPOUND.
2. PROPER GAUGE SETUP.
3. ALL DIMENSIONS HELD TO SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: B-7
TASK: 1
PAGE: 1

TASK:	PREPARE LAPPING PLATE
JOB:	MAKE TWO PARALLEL BLOCKS
TRADE:	MACHINIST
TOOLS AND MATERIALS:	LAPPING PLATE, KEROSINE OR NAPHTHA, OIL CAN, FINE LAPPING COMPOUND, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CLEAN LAPPING PLATE	1. PLACE LAPPING PLATE ON TABLE 2. APPLY KEROSINE OR NAPHTHA TO SURFACE OF LAPPING PLATE 3. USE OIL CAN AS APPLICATOR 4. WASH AND WIPE CLEAN WITH RAG 5. FINISH WIPE WITH BARE HAND TO REMOVE FINAL DUST AND GRIT
2. APPLY COMPOUND	1. APPLY THIN COAT OF LAPPING COMPOUND ON PLATE 2. THIN WITH KEROSINE IF NECESSARY

SKETCHES: DRAWING #7: PARALLEL BLOCKS

REFERENCES: REF. #2, PP. 127-128

TASK SHEET

JOB: B-7
TASK: 2
PAGE: 1

TASK: LAP BLOCKS

JOB: MAKE TWO PARALLEL BLOCKS

TRADE: MACHINIST

TOOLS AND MATERIALS: LAPPING BLOCK, KEROSINE OR NAPHTHA, OIL CAN, FINE LAPPING COMPOUND, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LAP FIRST BLOCK	1. WIPE ALL BLOCK SURFACES CLEAN WITH HAND 2. PLACE ONE FLAT SIDE ON LAPPING PLATE 3. APPLY LIGHT UNIFORM PRESSURE ON BLOCK WITH HAND NOTE: DO NOT PUSH DOWN ON BLOCK 4. RUB BLOCK OVER LAPPING PLATE USING A FIGURE EIGHT MOTION 5. LAP EACH SIDE FOR ABOUT THREE MINUTES IN SIMILAR MANNER
2. LAP SECOND BLOCK	REPEAT STEP 1
3. CLEAN LAPPED BLOCKS	REPEAT STEP 1

SKETCHES: DRAWING #7: PARALLEL BLOCKS

TASK SHEET

JOB: B-7
TASK: 3
PAGE: 1

TASK: CHECK WORK

JOB: MAKE TWO PARALLEL BLOCKS

TRADE: MACHINIST

TOOLS AND MATERIALS: SURFACE PLATE, JO BLOCKS, HEIGHT GAUGE, WORK PIECE, LAST WORD INDICATOR

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP SURFACE GAUGE	1. SET UP SURFACE PLATE NEARBY
	2. WIPE TOP OF SURFACE PLATE CLEAN WITH HAND
	3. SET HEIGHT GAUGE ON SURFACE PLATE
	4. MOUNT THE LAST WORD INDICATOR IN HEIGHT GAUGE
2. SET UP JO BLOCKS	1. SET UP ONE STACK OF JO BLOCKS TO BE EXACTLY 1/250"
	2. SET UP ANOTHER STACK OF JO BLOCKS TO BE EXACTLY 1.250"
	3. SET UP THIRD STACK OF JO BLOCKS TO BE EXACTLY 3.000" NOTE: REF. #2, PP. 451
3. INSPECT WORK	1. ADJUST HEIGHT GAUGE AND INDICATOR TO READ ZERO SETTING ON ANY STACK OF BLOCKS
	2. CLEAN LAPPED BLOCK THOROUGHLY
	3. SET SIDE OF BLOCK ON SURFACE TABLE RESPECTIVELY WITH THE SETTING OF THE HEIGHT GAUGE
	4. SLIDE BLOCK UNDER INDICATOR NOTE: WHEN BLOCK IS LAPPED TO THE FINISH DIMENSION ACCORDING TO PRINT SPECIFICATION THE INDICATOR WILL READ WITHIN 1/2 THOUSANDS OF ZERO
	5. CHECK ENTIRE SURFACE
	6. RESET HEIGHT GAUGE AND CHECK ALL THREE DIMENSIONS

3. INSPECT WORK (CON'T.)		NOTE: IT MAY BE NECESSARY TO LAP SURFACES AND CHECK SEVERAL TIMES TO ATTAIN THE REQUIRED TOLERANCE
	7.	REPEAT SAME PROCEDURE ON SECOND BLOCK
	8.	RECHECK ALL DIMENSIONS OF BOTH BLOCKS
	9.	INSPECT FINISH NOTE: FINISH SHOULD BE SMOOTH AND A DULL COLOR
4. CLEAN UP	1.	CLEAN LAPPING PLATE WITH KEROSINE OR NAPHTHA
	2.	CLEAN ALL TOOLS AND EQUIPMENT AND RETURN TO PROPER PLACES

SKETCHES: DRAWING #7: PARALLEL BLOCKS

REFERENCES: REF. #1, P. 4-17 AND PP. 6-4 TO 6-6
REF. #2, PP. 451-452

MACHINE SHOP PARALLEL BARS

BENCH WORK	8
MILLING	HM-4
SHAPER	5
DRILL PRESS	5
HEAT TREAT	2

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND CONSTRUCT A SET OF PARALLEL BARS ACCORDING TO SPECIFICATIONS; USING THE NECESSARY MACHINES AND PROCESSES CALLED FOR IN THE JOB.

CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINES FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS AND EQUIPMENT IN GOOD WORKING ORDER.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, AND MACHINES.
9. MAINTAIN SAFE WORKING HABITS.

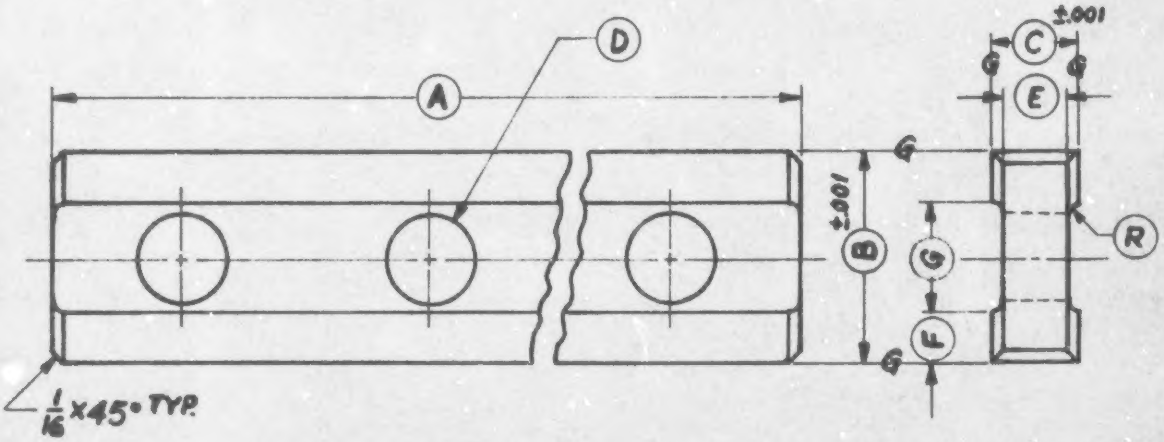
REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.

NOTE: THE CHART IN DRAWING #8 GIVES THE DIMENSIONS FOR TEN DIFFERENT SETS OF PARALLEL BARS. SETS 4, 7, 9, AND 10 HAVE HOLES DRILLED THROUGH THE CHANNEL. IF THESE SETS ARE CHOSEN, HOLES SHOULD BE DRILLED BEFORE HEAT TREATING.

TASK SHEETS FOR THIS JOB ARE DESIGNED FOR REF. #1 ON DRAWING #8. IF OTHER SETS ARE DESIRED, DIMENSIONS MUST BE CHANGED ACCORDINGLY. ALTHOUGH IT IS NOT CALLED FOR IN REF. #1 OF DRAWING #8, A JOB SHEET ON DRILL PRESS HAS BEEN ADDED FOR REFERENCE.



NOTE: ALLOW .012 FOR GRINDING
CARBURIZE & HARDEN

REF. NO.	A	B	C	D	E	F	G	R
1	5½	5/8	3/8		1/4	3/16	1/4	1/16
2	5½	3/4	3/8		1/4	1/4	1/4	1/16
3	6	1	3/8		1/4	5/16	3/8	1/16
4	6	1¼	3/8	1/2	1/4	5/16	5/8	1/16
5	7	3/4	1/2		3/8	1/4	1/4	1/16
6	7	1	1/2		3/8	5/16	3/8	1/16
7	7	1¼	1/2	1/2	3/8	5/16	5/8	1/16
8	7½	1	3/4		1/2	1/4	1/2	1/8
9	7½	1¼	3/4	1/2	1/2	5/16	5/8	1/8
10	8	1½	3/4	1/2	1/2	3/8	3/8	1/8

DRAWING NO. 8	PARALLEL BARS	TOLERANCE CHART
MILLING JOB NO. 4 SHAPER JOB NO. 5 SURFACE GRINDER JOB NO. 2 DRILL PRESS JOB NO. 3	MATERIAL : C.R. STEEL FINISH : MACHINE & GRIND SCALE : NONE	FRACTIONS ± 1/64 DECIMALS ± .005 ANGLES ± 1/2°

S-5a

JOB SHEET
IN
SHAPER

JOB: MAKE PARALLEL BARS

MATERIALS: TWO PIECES 5 1/2" X 3/4" X 1/2" COLD ROLLED STEEL WITH ENDS SQUARED

TOOLS AND EQUIPMENT: SHAPER, SHAPER VISE, SHAPER TOOL HOLDER, TOOL BIT, PARALLELS, COMBINATION SQUARE, 1" MICROMETER, 10" MILL FILE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 37-1 TO 37-16 AND REF. #2, PP. 499-523. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

S-5a-1	CHECK THE SHAPER FOR PROPER RUNNING CONDITION, DRILL DRIFT, S-1-1
S-5a-2	SET UP SHAPER, T-NUT, S-2-2
S-5a-3	MACHINE WORK PIECES

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. PROPER MACHINE SETUP.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. ALL SURFACES SQUARE AND PARALLEL TO EACH OTHER.
4. SMOOTH MACHINE FINISH.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: S-5a
TASK: 3
PAGE: 1

TASK: MACHINE WORK PIECE

JOB: MAKE PARALLEL BARS

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, SHAPER VISE, SHAPER TOOL HOLDER, TOOL BIT, PARALLELS, 10" MILL FILE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MACHINE FIRST SIDE OF EACH PART	1. REFER TO STEP BLOCK, S-3a-3 2. REMOVE 1/16" TOTAL MATERIAL
2. MACHINE SECOND SIDE OF EACH PART	1. REPEAT STEP 1 2. HOLD THICKNESS TO .385" + .010" FOR GRINDING
3. REMOVE BURRS	1. MOUNT IN VISE 2. FILE BURRS
4. MACHINE FIRST EDGE OF EACH PART	1. REPEAT STEP 1 2. USE PARALLEL BARS
5. MACHINE SECOND EDGE OF EACH PART	1. REPEAT STEP 4 2. HOLD TO .635" + .010" FOR GRINDING NOTE: BOTH PIECES MAY BE MACHINED TOGETHER ON SECOND EDGE
6. CLEAN MACHINE	REFER TO DRILL DRIFT, S-1-3
7. REMOVE BURRS	REPEAT STEP 3

ROUTE TO BENCH

SKETCHES: DRAWING #8: PARALLEL BARS

REFERENCES: REF. #1, PP. 37-1 TO 37-16
REF. #2, PP. 499-523

B-8

JOB SHEET
IN
BENCH WORK

JOB: MAKE PARALLEL BARS

MATERIALS: TWO PIECES 5 1/2" X 3/4" X 1/2" COLD ROLLED STEEL MACHINED FOR LAYOUT

TOOLS AND EQUIPMENT: LAYOUT FLUID, COMBINATION SQUARE, SCRIBE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 6-1 TO 6-10 AND REF. #2, PP. 62-66. CHECK WITH INSTRUCTOR AFTER COMPLETION OF JOB.

PROCEDURES AND/OR TASKS: B-8-1 LAYOUT TO SPECIFICATIONS

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. ALL DIMENSIONS HELD TO SPECIFICATIONS.
2. CRAFTSMANLIKE PERFORMANCE.

JOB SHEET

JOB: B-8
TASK: 1
PAGE: 1

TASK:	LAYOUT TO SPECIFICATIONS
JOB:	MAKE PARALLEL BARS
TRADE:	MACHINIST
TOOLS AND MATERIALS:	LAYOUT FLUID, COMBINATION SQUARE, SCRIBE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. APPLY LAYOUT FLUID	1. APPLY LAYOUT FLUID TO BOTH SIDES OF EACH WORK PIECE
	2. ALLOW TO DRY
2. LAYOUT FIRST SIDE OF ONE BAR	1. SET COMBINATION SQUARE ON 3/16"
	2. POSITION SQUARE HEAD ON EITHER EDGE WITH RULE FLAT ON INKED SURFACE
	3. POSITION SCRIBE AT END OF RULE
	4. SCRIBE LINE DOWN LENGTH OF PART NOTE: THIS IS DIMENSION "F" ON THE DRAWING
	5. REPEAT FROM OTHER EDGE OF PART
3. LAYOUT SECOND SIDE OF FIRST BAR	1. TURN BAR OVER
	2. REPEAT STEP 2
4. LAYOUT SECOND BAR	1. REPEAT STEPS 2 AND 3
	2. RETURN LAYOUT EQUIPMENT TO PROPER PLACE

ROUTE TO SHAPER

SKETCHES: DRAWING #8: PARALLEL BARS

REFERENCES: REF. #1, PP. 6-1 TO 6-10
REF. #2, PP. 62-66

JOB SHEET
IN
SHAPER

S-5b

JOB: MAKE PARALLEL BARS

MATERIALS: TWO PIECES 5 1/2" X 3/4" X 1/2" COLD ROLLED STEEL MACHINED AND LAID OUT FOR FINISH SHAPING.

TOOLS AND EQUIPMENT: SHAPER, SHAPER VISE, SHAPER TOOL HOLDER, TOOL BIT, PARALLELS, COMBINATION SQUARE, 1" MICROMETER, 10" MILL FILE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 37-1 TO 37-16 AND REF. #2, PP. 499-523. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

S-5b-1 CHECK THE SHAPER FOR PROPER RUNNING CONDITION REFER TO JOB S-5a
S-5b-2 SET UP SHAPER
S-5b-3 MACHINE INSDIE CHANNELS

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. OIL RESERVOIRS FILLED.
2. PROPER MACHINE SETUP.
3. MACHINE VISE INDICATED TRUE.
4. ALL DIMENSIONS HELD TO SPECIFICATIONS.
5. SMOOTH MACHINE FINISH.
6. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: S-5b
TASK: 2
PAGE: 1

TASK: SET UP SHAPER

JOB: MAKE PARALLEL BARS

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, SHAPER VISE, SHAPER TOOL HOLDER, TOOL BIT, PARALLELS, 10" MILL FILE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SELECT PROPER TOOL	1. REMOVE OLD TOOL FROM THE TOOL HOLDER
	2. SELECT SHARP 1/16" ROUND NOSE TOOL
	3. SET UP TOOL AS IN S-5a-2
2. MOUNT WORK	1. PLACE WORK FLAT IN VISE WITH ANY LAYOUT SURFACE UP
	2. ADJUST TABLE UNTIL TOOL IS OVER WORK BETWEEN LAYOUT LINES

SKETCHES: DRAWING #8: PARALLEL BARS

REFERENCES: REF. #1, PP. 37-1 TO 37-16
REF. #2, PP. 499-523

TASK SHEET

JOB: S-5b
TASK: 3
PAGE: 1

TASK: MACHINE INSIDE CHANNELS

JOB: MAKE PARALLEL BARS

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, SHAPER VISE, SHAPER TOOL HOLDER, TOOL BIT, PARALLELS, 10" MILL FILE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MACHINE FIRST CHANNEL	1. PUT SAFETY GOGGLES ON 2. START MACHINE 3. ENGAGE RAM CLUTCH 4. LOWER TOOL HEAD UNTIL TOOL BEGINS TO CUT THE SURFACE 5. AT EACH BACK STROKE OF THE RAM LOWER TOOL HEAD .005" 6. CONTINUE UNTIL .060" HAS BEEN REMOVED 7. HAND FEED TABLE BOTH DIRECTIONS TO CUT TO LAYOUT LINES NOTE: DO NOT POWER FEED
2. REMOVE BURRS	1. REMOVE WORK PIECE 2. PLACE IN BENCH VISE 3. FILE LIGHTLY
3. MACHINE SECOND CHANNEL	1. MOUNT FIRST BAR WITH REMAINING LAID OUT SURFACE UP 2. REPEAT STEPS 1 AND 2 NOTE: DIMENSION "E" SHOULD AUTOMATICALLY BE 1/4" THICK
4. MACHINE SECOND BAR	REPEAT STEPS 1, 2, AND 3
5. CLEAN MACHINE	SAME AS JOB S-5a
6. INSPECT	1. "C"-3/8" 2. "F"-3/16" 3. "E"-1/4" 4. "G"-1/4" 5. "B"-5/8" 6. "A"-5 1/2"

7. ROUTE TO HEAT TREAT REFER TO JOB HT-1

SKETCHES: DRAWING #8: PARALLEL BARS

REFERENCES: REF. #1, PP. 37-1 TO 37-16
REF. #2, PP. 499-523

OPTIONAL HM-4

JOB SHEET
IN
MILLING

JOB: MAKE PARALLEL BARS

MATERIALS: TWO PIECES 5 9/16" X 3/4" X 1/2" COLD ROLLED STEEL BARS

TOOLS AND EQUIPMENT: MILLING MACHINE, MILLING MACHINE VISE, MILL FILE, MILLING ARBOR AND COLLARS, HELICAL MILLING CUTTER, FORM MILLING CUTTER, PARALLELS, MICROMETERS, HAMMER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 38-1. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

HM-4-1	CHECK MILLING MACHINE FOR PROPER RUNNING CONDITIONS. T-NUT, HM-1-1
HM-4-2	SET UP HORIZONTAL MILL. T-NUT, HM-1-3 NOTE: USE A CUTTER SLIGHTLY WIDER THAN WIDEST CUT REQUIRED
HM-4-3	MOUNT WORK IN VISE. T-NUT, M-1-2 NOTE: LAYOUT AT BENCH, B-8-1
HM-4-5	MILL CHANNELS

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. PROPER MACHINE SETUP
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. SMOOTH MACHINE FINISH.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS

TASK SHEET

JOB: HM-4
TASK: 4
PAGE: 1

TASK: MILL SIDES AND EDGES

JOB: MAKE PARALLEL BARS

TRADE: MACHINIST

TOOLS AND MATERIALS: MILLING MACHINE, MILLING MACHINE VISE, HELICAL MILLING CUTTER, MILL FILE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MILL FIRST SIDE OF EACH WORK PIECE	1. REMOVE .060" FROM FIRST SIDE OF EACH WORK PIECE 2. REFER TO STEP BLOCK, HM-2-4
2. MILL SECOND SIDE OF EACH WORK PIECE	1. REPEAT STEP 1 2. HOLD THICKNESS TO .385" + .010" TO ALLOW FOR GRINDING STOCK
3. REMOVE BURRS	1. LOOSEN VISE 2. REMOVE WORK PIECE 3. DEBURR SHARP EDGES WITH FILE
4. MILL FIRST EDGE OF EACH WORK PIECE	REPEAT STEP 1
5. MILL SECOND EDGE OF EACH PART	1. REPEAT STEP 1 2. HOLD WIDTH TO .635" + .010" FOR GRINDING 3. NOTE: BOTH PARTS MAY BE MACHINED TOGETHER ON EDGES
6. REMOVE BURRS	REPEAT STEP 3
7. CLEAN MILL	REFER TO STEP BLOCK, HM-2-4
8. ROUTE TO HEAT TREAT	REFER TO JOB HT-1

SKETCHES: DRAWING #8: PARALLEL BARS

REFERENCES: REF. #1, PP. 38-1 TO 38-37
REF. #2, PP. 524-564

TASK SHEET

JOB: HM-4
TASK: 5
PAGE: 1

TASK: MILL CHANNELS
JOB: MAKE PARALLEL BARS
TRADE: MACHINIST
TOOLS AND MATERIALS: HORIZONTAL MILLING MACHINE, MILLING MACHINE VISE, FORM MILLING CUTTER, MILL FILE, MICROMETERS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP CUTTERS	1. REMOVE HELICAL CUTTER 2. SELECT FORM CUTTER 1/4" WIDE WITH 1/16" RADIUS GROUND ON BOTH EDGES 3. MOUNT FORM CUTTER IN SAME MANNER AS HELICAL CUTTER 4. ADD SPACERS TO MAKE UP FOR DIFFERENCE IN WIDTH
2. MOUNT WORK IN VISE	1. PLACE ONE WORK PIECE IN VISE LAID OUT SURFACE UP 2. USE SAME PARALLELS AS BEFORE 3. TIGHTEN VISE
3. MAKE FINAL ADJUSTMENT	1. MOVE TABLE BOTH DIRECTIONS UNTIL CUTTER IS OVER WORK PIECE 2. PUT SAFETY GOGGLES ON 3. TURN MACHINE ON 4. ADJUST MACHINE UNTIL CUTTERS ARE EXACTLY BETWEEN LAYOUT LINES 5. LOCK TABLE CROSS FEED
4. CUT CHANNEL ON FIRST SIDE OF FIRST WORK PIECE	1. RAISE TABLE UNTIL THE WORK JUST TOUCHES THE CUTTER 2. MOVE THE TABLE TOWARD END UNTIL CUTTER IS OFF WORK NOTE: BE SURE DIRECTION OF CUTTER IS CORRECT, REF. #1, P. 38-22 3. RAISE TABLE .060" 4. OIL WORK 5. MACHINE CHANNEL DOWN THE ENTIRE LENGTH OF PART

5.	REMOVE BURR	1. 2.	REMOVE PART FROM VISE FILE BURRS LIGHTLY
6.	CUT CHANNEL ON SECOND SIDE OF FIRST WORK PIECE	1. 2.	REPEAT STEPS 3 AND 4 NOTE: THIS WILL HOLD DIMENSION "E" REMOVE BURRS AS IN STEP 5
7.	MACHINE SECOND WORK PIECE		REPEAT STEPS 2-6
8.	CLEAN MACHINE		REFER TO T-CUT, HM-1-4
9.	INSPECT	1. 2. 3. 4. 5. 6.	"C"-3/8" "F"-3/16" "E"-1/4" "G"-1/4" "B"-5/8" "A"-5 1/2"
10.	HEAT TREAT	1. 2.	HEAT TREAT AS IN PARALLEL BLOCKS, HT-1 HEAT TREAT AND QUENCH IN VERTICAL POSITION

ROUTE TO SURFACE GRINDER

SKETCHES: DRAWING #8: PARALLEL BARS

REFERENCES: REF. #1, PP. 38-1 TO 38-38
REF. #2, PP. 524-564

DP-5

JOB SHEET
IN
DRILL PRESS

JOB: MAKE PARALLEL BARS

MATERIALS: TWO PIECES 5 1/2" X 5/8" X 3/8" COLD ROLLED STEEL MILLED OR SHAPED TO SPECIFICATIONS

TOOLS AND EQUIPMENT: DRILL PRESS, DRILL PRESS VISE, DRILL CHUCK AND KEY, 1/2" STRAIGHT SHANK DRILL, COUNTERSINK, PARALLELS, MILL FILE, CUTTING OIL

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REFER TO REF. #1, PP. 34-1 TO 34-24 AND REF. #2, PP. 203-228. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

THE CHART IN DRAWING #8 GIVES THE DIMENSIONS FOR TEN DIFFERENT SETS OF PARALLEL BARS. SETS 4, 7, 9, AND 10 HAVE HOLES DRILLED THROUGH THE CHANNEL. IF THESE SETS ARE CHOSEN, HOLES ARE TO BE DRILLED BEFORE THE HEAT TREATING PROCESS.

PROCEDURES AND/OR TASKS:

DP-5-1	CHECK MACHINE FOR PROPER RUNNING CONDITIONS
DP-5-2	DRILL 1/2" HOLES. REFER TO CLAMP STRAP, JOB DP-1-3
DP-5-3	COUNTERSINK HOLES LIGHTLY ON BOTH SIDES. REFER TO DRILL DRIFT, JOB DP-2-3 NOTE: LOCATION OF HOLES IS NOT GIVEN ON THE DRAWING. THE NUMBER OF HOLES AND THEIR LOCATION HAS BEEN LEFT TO INDIVIDUAL PREFERENCE. THE STUDENTS SHOULD BE ABLE TO LAYOUT HOLES IN A PROPER AND ORDERLY MANNER. REFER TO CLAMP STRAP, JOB B-1a

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. LAYOUT WORK PROPERLY DONE.
2. PROPER MACHINE SETUP.
3. HOLES DRILLED TO SPECIFICATIONS.
4. PROPER COUNTERSINK.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, WORK, MACHINES, AND STANDARDS.

JOB SHEET
II.
SURFACE GRINDING

JOB: MAKE PARALLEL BARS

MATERIALS: TWO PIECES OF CARBURIZED AND HARDENED STEEL MILLED OR SHAPED TO SPECIFICATIONS

TOOLS AND EQUIPMENT: SURFACE GRINDER, MAGNETIC CHUCK, DIAMOND DRESSER, ANGLE PLATE, 3" "C" CLAMP, SLIP STONE, DEPTH MICROMETER, 2" AND 3" MICROMETERS

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 33-1 TO 33-14 AND REF. #2, PP. 565-581. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

SG-2-1 CHECK MACHINE FOR PROPER RUNNING CONDITION, PARALLEL BLOCKS, SG-1-1
SG-2-2 SET UP MACHINE FOR GRINDING, PARALLEL BLOCKS, SG-1-2
SG-2-3 GRIND WORK PIECES

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. ELECTROMAGNET HOLDING POWER.
2. CORRECT SETUP.
3. GRINDING WHEEL SHARP AND FREE OF CRACKS AND FLAWS.
4. ALL DIMENSIONS HELD TO SPECIFICATIONS.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: SG-2
TASK: 3
PAGE: 1

TASK: GRIND WORK PIECE

JOB: MAKE PARALLEL BARS

TRADE: MACHINIST

TOOLS AND MATERIALS: SURFACE GRINDER, TOOLMAKER'S SOLID SQUARE, 2" AND 3" DEPTH MICROMETERS, 3" "C" CLAMP, ANGLE PLATE, BRASS HAMMER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. GRIND ONE SIDE BOTH PIECES	1. REFER TO PARALLEL BLOCKS, SG-1-3 NOTE: THE DIMENSION "E" NOT TO BE GROUND 2. REMOVE .008" TO .010" FROM FIRST SIDE
2. GRIND SECOND SIDE	1. REPEAT STEP 1 2. CHECK WORK WITH DEPTH MICROMETER WHILE IT IS ON MAGNETIC CHUCK 3. HOLD FINISH SIZE TO .375 ± .001
3. GRIND ONE EDGE OF FIRST PART	1. REFER TO PARALLEL BLOCKS, SG-1-3 2. REMOVE .008" TO .010"
4. GRIND FIRST EDGE OF SECOND PART	REPEAT STEP 3
5. GRIND SECOND EDGE OF BOTH PARTS	1. REFER TO PARALLEL BLOCKS, SG-1-3 2. HOLD FINISH WIDTH TO .625 ± .001
6. CLEAN UP	REFER TO PARALLEL BLOCKS, SG-1-3
7. REMOVE BURRS	REFER TO PARALLEL BLOCKS, SG-1-3
8. INSPECT	1. "B" DIMENSION 2. "C" DIMENSION 3. FINISH

SKETCHES: DRAWING #8: PARALLEL BARS

REFERENCES: REF. #1, PP. 33-1 TO 33-14
REF. #2, PP. 565-581

MACHINE SHOP TEST BAR

ENGINE LATHE	2
CYLINDRICAL GRINDER	1
HEAT TREAT	4

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND CONSTRUCT A TEST BAR ACCORDING TO SPECIFICATIONS; USING MACHINES, TOOLS, EQUIPMENT, AND MATERIALS CALLED FOR IN THE JOB.

CHECKING STANDARDS

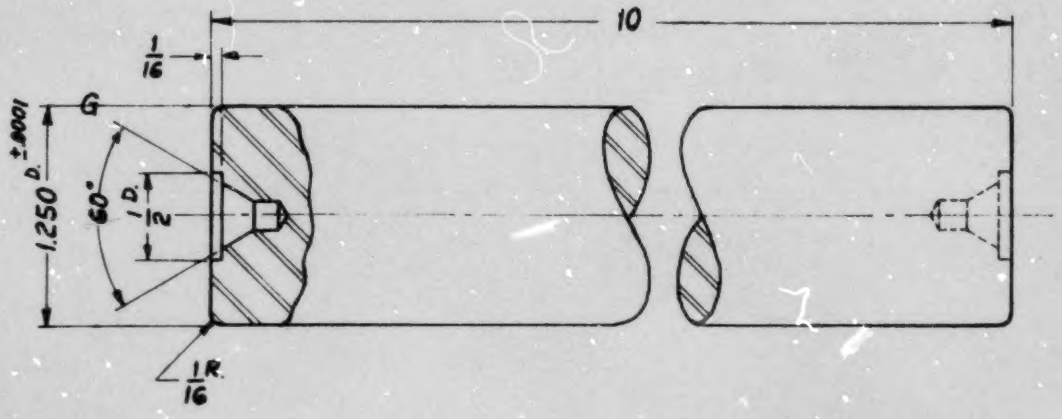
1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
3. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1. WALKER, JOHN R., MODERN METALWORKING.

REF. #2. LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.

NOTE: BOTH ENDS TYPICAL


10
1/16
G
1.250 D. ±.0001
60°
1/2 D.
1/16 R.

ALLOW .012 TO .015 FOR GRINDING
CARBURIZE & HARDEN

DRAWING NO. 14	TEST BAR	TOLERANCE CHART
LATHE JOB NO. 2 CYLINDRICAL GRINDER JOB NO. 1	MATERIAL : C.R. STEEL FINISH : GRIND SCALE : FULL SIZE	FRACTIONS ±1/64 DECIMALS ±.005 ANGLES ±1/2°

EL-2

JOB SHEET
IN
ENGINE LATHE

JOB: MAKE TEST BAR

MATERIALS: ONE PIECE 1 3/8" ROUND X 10 1/8" LENGTH COLD ROLLED STEEL

TOOLS AND EQUIPMENT: ENGINE LATHE, TOOL HOLDER, TOOL BIT, UNIVERSAL CHUCK, FACE PLATE, JACOBS CHUCK AND KEY, LIVE AND DEAD CENTER, 1 1/2" LATHE DOG, #E2 CENTER DRILL, 10" MILL FILE, 1" AND 2" MICROMETER, INSIDE CALIPERS

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 36-1 TO 36-44 AND REF. #2, PP. 462-493. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

EL-2-1	CHECK MACHINE FOR PROPER RUNNING CONDITION, STUD, EL-1-1
EL-2-2	MOUNT WORK IN UNIVERSAL CHUCK, STUD, EL-1-2b
EL-2-3	FACE END, STUD, EL-1-4 NOTE: CHECK REF. #1, P. 36-14 FOR SPEED SETTING
EL-2-4	DRILL CENTER HOLE IN END
EL-2-5	CUT RECESS IN ENDS
EL-2-6	SET UP FOR TURNING WORK PIECE BETWEEN CENTERS
EL-2-7	TURN WORK PIECE
EL-2-8	CUT RADII
EL-2-9	HEAT TREAT, PARALLEL BLOCKS, HT-1
EL-2-10	LAP CENTERS

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. OIL RESERVOIRS FILLED TO PROPER LEVEL.
2. PROPER MACHINE SETUP.
3. ACCURACY OF CENTERS.
4. ALL DIMENSIONS HELD TO SPECIFICATIONS.
5. SMOOTH MACHINE FINISH.
6. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: EL-2
TASK: 4
PAGE: 1

TASK: DRILL CENTER HOLE IN ENDS

JOB: MAKE TEST BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, #E2 CENTER DRILL, WORK PIECE, JACOBS CHUCK AND KEY

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP CENTER DRILL	1. INSERT JACOBS CHUCK INTO TAILSTOCK SPINDLE WITH A QUICK MOTION 2. OPEN CHUCK BY HAND 3. PLACE #E2 CENTER DRILL 1 1/4" IN CHUCK 4. TIGHTEN CHUCK WITH CHUCK KEY
2. POSITION CENTER DRILL	1. SLIDE TAILSTOCK TO THE LEFT UNTIL POINT OF CENTER DRILL IS 1/4" FROM END OF WORK PIECE 2. TIGHTEN LOCKING LEVER ON TAILSTOCK SPINDLE
3. CENTER DRILL FIRST HOLE	1. PUT SAFETY GOGGLES ON 2. TURN SPINDLE ON-FORWARD 3. HAND FEED CENTER DRILL SLOWLY INTO WORK 4. ALLOW 3/4 OF ANGLE ON CENTER TO CUT INTO WORK PIECE 5. TURN TAILSTOCK HANDWHEEL COUNTERCLOCKWISE TO THE BACK CENTER DRILL OUT OF HOLE 6. LOOSEN CHUCK WITH CHUCK WRENCH AND REMOVE WORK PIECE
4. DRILL SECOND END	1. REVERSE WORK PIECE IN CHUCK 2. TIGHTEN CHUCK 3. CENTER DRILL HOLE IN SECOND END SAME AS FIRST 4. LOOSEN TAILSTOCK LOCKING CLAMP 5. SLIDE TAILSTOCK TO RIGHT END OF WAYS

5. REMOVE TAILSTOCK	1. REMOVE CENTER DRILL 2. REMOVE CHUCK FROM TAILSTOCK BY TURNING THE HANDWHEEL COUNTERCLOCKWISE UNTIL THE CHUCK BREAKS LOOSE NOTE: CHUCK WILL GET TIGHT BEFORE IT BREAKS LOOSE

SKETCHES: DRAWING #14: TEST BAR

REFERENCES: REF. #2, PP. 479-480

TASK SHEET

JOB: EL-2
TASK: 5
PAGE: 1

TASK: CUT RECESS IN ENDS

JOB: MAKE TEST BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, POINTED FACING TOOL, INSIDE CALIPERS, WORK PIECE, 1" MICROMETER

TASK BREAKDOWN:

STEPS	KEY POINTS
1. INSTALL TOOL	1. SELECT FACING TOOL WITH POINT
	2. PLACE THE TOOL IN RIGHT HAND TOOL HOLDER WITH THE CUTTING EDGE EXTENDED 1/2"
	3. TIGHTEN TOOL IN POSITION
2. SET UP HOLDER	1. PLACE TOOL HOLDER IN TOOL POST
	2. ADJUST TOOL POST TO POSITION TOOL PARALLEL TO MACHINE WAYS NOTE: HAVE POINT OF TOOL A LITTLE CLOSER TO OPERATOR THAN REMAINDER OF TOOL
	3. TIGHTEN TOOL HOLDER IN POST WITH WRENCH
3. CUT FIRST RECESS	1. MOVE CARRIAGE AND CROSS SLIDE TO POSITION POINT OF TOOL NEAR CENTER DRILL HOLE NOTE: SEE REF. #1, FIG. 36-74, P. 36-24
	2. PUT SAFETY GOGGLES ON
	3. START MACHINE FORWARD
	4. MOVE CARRIAGE IN UNTIL POINT OF TOOL IS 1/16" INSIDE CENTER DRILLED HOLE
	5. MOVE CROSS SLIDE OUT UNTIL TOOL CUTS DIAMETER OF RECESS TO 1/2"
	6. STOP THE MACHINE
	7. CHECK DIAMETER OF RECESS WITH INSIDE CALIPERS AND 1" MICROMETER
	8. REMOVE WORK PIECE

4. CUT RECESS IN OTHER END   REPEAT STEP 3

SKETCHES: DRAWING #14: TEST BAR

REFERENCES: REF. #1, PP. 36-33 TO 36-34

TASK SHEET

JOB: EL-2
TASK: 6
PAGE: 1

TASK: SET UP FOR TURNING WORK PIECE BETWEEN CENTERS

JOB: MAKE TEST BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, FACE PLATE, 1 1/2" LATHE DOG, TOOL BIT, LIVE AND DEAD CENTER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. INSTALL FACE PLATE	1. CLEAN THREADS ON HEADSTOCK SPINDLE
	2. CLEAN THE THREADS ON INSIDE FACE PLATE
	3. SCREW FACE PLATE ONTO SPINDLE
2. MOUNT CENTERS	1. WIPE TAPER IN HEADSTOCK SPINDLE CLEAN WITH RAG
	2. WIPE THE TAPER TAILSTOCK SPINDLE CLEAN
	3. INSERT A DEAD CENTER IN HEADSTOCK SPINDLE
	4. INSERT LIVE CENTER IN TAILSTOCK SPINDLE
3. MOUNT LATHE DOG	1. SLIDE 1 1/2" LATHE DOG ONTO WORK PIECE NEAR ONE END
	2. HAVE BENT TAIL POINTING OUTWARD
	3. PLACE A THIN PIECE OF METAL BETWEEN SET SCREW ON DOG AND WORK PIECE TO PREVENT MARRING
	4. TIGHTEN DOG SET SCREW
4. MOUNT WORK BETWEEN CENTERS	1. SLIDE TAILSTOCK TO LEFT LEAVING 10 1/2" BETWEEN CENTERS
	2. LOCK TAILSTOCK IN PLACE
	3. ENGAGE HEADSTOCK CENTER IN CENTER HOLE ON DOG END OF WORK PIECE
	4. FIT THE TAIL OF LATHE DOG IN FACE PLATE NOTE: BE SURE LATHE DOG FITS IN SLOT AND DOES NOT BIND

4. MOUNT WORK BETWEEN CENTERS (CON'T.)	5. HOLD WORK PIECE IN LEFT HAND TO SUPPORT TAIL END 6. ADVANCE TAILSTOCK SPINDLE UNTIL CENTER IS ENGAGED IN CENTER HOLE NOTE: APPLY ONLY ENOUGH PRESSURE TO ELIMINATE PLAY IN THE WORK PIECE 7. TIGHTEN TAILSTOCK BINDING LEVER
5. SET UP TOOL	1. SELECT TOOL WITH SMALL RADIUS ON NOSE 2. MOUNT TOOL IN TOOL HOLDER 3. SWING TOOL HOLDER IN TOOL POST UNTIL TOOL IS PERPENDICULAR TO WORK 4. TIGHTEN TOOL HOLDER IN TOOL POST WITH SET SCREW NOTE: THE TOOL POST SHOULD BE MOUNTED ON THE LEFT SIDE OF COMPOUND REST

SKETCHES: DRAWING #14: TEST BAR

REFERENCES: REF. #1, PP. 36-16 TO 36-20
REF. #2, PP. 481-482

TASK SHEET

JOB: EL-2
TASK: 7
PAGE: 1

TASK: TURN WORK PIECE

JOB: MAKE TEST BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, FACE PLATE, 1 1/2" LATHE DOG, TOOL BIT, LIVE AND DEAD CENTER, 2" MICROMETER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MAKE FINAL ADJUSTMENTS	1. MOVE CARRIAGE AND CROSS SLIDE TO POSITION TOOL NEAR RIGHT END AND ABOUT 1 1/16" OFF WORK PIECE
	2. SET MACHINE SPEED AT 200 RPM
	3. SET FEED AT .007" CUT PER REVOLUTION
2. ROUGH TURN WORK	1. PUT SAFETY GOGGLES ON
	2. START MOTOR
	3. MOVE CROSS SLIDE IN UNTIL THE TOOL TOUCHES WORK
	4. MOVE CARRIAGE TO RIGHT UNTIL TOOL IS OFF WORK PIECE
	5. FEED CROSS SLIDE IN .080" BY THE DIAL
	6. ENGAGE LONGITUDINAL FEED LEVER
	7. DISENGAGE FEED LEVER WHEN CUTTING TOOL IS 1/4" FROM LATHE DOG
	8. RETURN CARRIAGE AND TOOL TO THE STARTING POINT
	9. STOP MACHINE
3. FINISH TURN WORK	1. CHECK OUTSIDE DIAMETER (OD) WITH 2" MICROMETER
	2. MOVE CROSS SLIDE IN TO REMOVE MATERIAL NECESSARY TO BRING OD TO 1.265" NOTE: THIS LEAVES .015" FOR GRINDING
	3. START MACHINE

3. FINISH TURN WORK (CON'T.)	4. ENGAGE LONGITUDINAL FEED CLUTCH 5. DISENGAGE FEED LEVER WHEN TOOL REACHES SHOULDER LEFT BY ROUGH CUT 6. STOP MACHINE 7. REMOVE WORK PIECE
4. TURN THAT PORTION UNDER LATHE DOG	1. REMOVE LATHE DOG FROM THE WORK PIECE 2. MOUNT DOG ON OTHER END NOTE: PLACE A SMALL PIECE OF THE SOFT SHEET METAL BETWEEN DOG SET SCREW AND WORK PIECE TO PREVENT SCARRING 3. REPEAT STEPS 1-3 4. FINISH TO BLEND WITH PREVIOUS CUTS

SKETCHES: DRAWING #14: TEST BAR

REFERENCES: REF. #1, PP. 36-16 TO 36-20
REF. #2, PP. 481-482

TASK SHEET

JOB: EL-2
TASK: 8
PAGE: 1

TASK: CUT RADII

JOB: MAKE TEST BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, FACE PLATE, 1 1/2" LATHE DOG, TOOL BIT, LIVE AND DEAD CENTER, 2" MICROMETER, TOOL GROUND CONCAVE FOR 1/16" RADII, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP AND POSITION TOOL	1. SELECT CONCAVE TOOL WITH 1/16" RADII 2. MOUNT TOOL IN RIGHT HAND TOOL HOLDER 3. POSITION TOOL PARALLEL TO MACHINE WAYS 4. MOVE CARRIAGE AND CROSS SLIDE TO POSITION TOOL AT RIGHT END OF WORK PIECE NOTE: BE CAREFUL NOT TO HIT CENTER
2. CUT FIRST RADIUS	1. PUT SAFETY GOGGLES ON 2. TURN MACHINE ON 3. FEED CROSS SLIDE IN UNTIL CENTER OF RADII TOOL TOUCHES CORNER 4. FEED CROSS SLIDE IN .070" 5. STOP MACHINE
3. CUT RADIUS ON OPPOSITE END	1. REMOVE WORK PIECE 2. MOUNT LATHE DOG ON OPPOSITE END 3. MOUNT WORK PIECE ON CENTERS AS BEFORE 4. REPEAT STEP 2 5. REMOVE WORK PIECE
4. CLEAN MACHINE	1. CLEAN AND STORE LATHE DOG 2. REMOVE, CLEAN, AND STORE FACE PLATE 3. REMOVE CHIPS WITH BRUSH 4. WIPE MACHINE WITH RAG

4. CLEAN MACHINE (CON'T.)   5. DISPOSE OF WASTE

ROUTE TO HEAT TREAT

SKETCHES: DRAWING #14: TEST BAR

REFERENCES: REF. #1, PP. 36-16 TO 36-20
REF. #2, PP. 479-483

TASK SHEET

JOB: EL-2
TASK: 10
PAGE: 1

TASK:	LAP CENTERS
JOB:	MAKE TEST BAR
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ENGINE LATHE, 3-JAW CHUCK, CHUCK KEY. CENTER LAP, WORK PIECE

TASK BREAKDOWN:

1. SET UP LATHE	1. SELECT CENTER LAP 2. MOUNT SHANK OF CENTER LAP IN THE CHUCK 3. TIGHTEN SECURELY IN CHUCK
2. LAP CENTERS	1. TURN LATHE ON 2. HOLD WORK PIECE IN HAND 3. INSERT CENTER DRILL HOLE OVER LAP NOTE: THIS WILL REMOVE THE SCALE LEFT BY HEAT TREAT 4. LAP OPPOSITE END

ROUTE WORK TO CYLINDER GRINDER

SKETCHES: DRAWING #14: TEST BAR

CG-1

JOB SHEET
IN
CYLINDRICAL GRINDER

JOB: MAKE TEST BAR

MATERIALS: WORK PIECE, BAR OF HARDENED STEEL WITH LAPPED CENTER AND .012" TO .015" STOCK FOR GRINDING

TOOLS AND EQUIPMENT: CYLINDRICAL GRINDER, GRINDER DOG, DIAMOND DRESSER, HONE, 2" MICROMETERS

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, PP. 33-1 TO 33-15 AND REF. #2, PP. 566-567. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

CG-1-1	CHUCK MACHINE FOR PROPER RUNNING CONDITION
CG-1-2	SET UP MACHINE FOR GRINDING
CG-1-3	GRIND WORK PIECE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. OIL RESERVOIRS FILLED TO OPERATING LEVEL.
2. COOLANT RESERVOIR FILLED TO PROPER LEVEL.
3. COOLANT FLOW SUFFICIENT FOR JOB.
4. WHEEL TRUE AND FREE OF FLAWS.
5. TABLE FEED REVERSING DOGS FUNCTIONING PROPERLY.
6. GUARDS IN PLACE AND TIGHT.
7. PROPER MACHINE SETUP.
8. DIMENSIONS HELD TO SPECIFICATIONS.
9. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: CG-1
TASK: 1
PAGE: 1

TASK: CHECK MACHINE FOR PROPER RUNNING CONDITION

JOB: MAKE TEST BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: CYLINDRICAL GRINDER, OIL, HAMMER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LUBRICATE MACHINE	1. PLACE ONE OR TWO DROPS OF OIL IN EACH OIL CAP 2. FILL OIL RESERVOIR TO THE PROPER LEVEL 3. OIL WAYS LIGHTLY
2. CHECK COOLANT	1. CHECK LEVEL OF COOLANT IN TANK 2. FILL IF NECESSARY
3. CHECK GUARDS	ALL GUARDS IN PLACE NOTE: SPLASH GUARD MAY BE REMOVED UNTIL SETUP IS COMPLETED
4. TEST GRINDING WHEEL FOR SOUNDNESS	1. SELECT A METAL HAMMER 2. TAP WHEEL LIGHTLY ON SIDES WITH HAMMER IN SEVERAL PLACES 3. LISTEN FOR RING IN WHEEL 4. IF DULL OR DEAD SOUND IS OBTAINED, REPLACE WHEEL

SKETCHES: DRAWING #14: TEST BAR

REFERENCES: REF. #1, PP. 33-1 TO 33-14
REF. #2, PP. 565-581

TASK SHEET

JOB: CG-1
TASK: 2
PAGE: 1

TASK: SET UP MACHINE FOR GRINDING

JOB: MAKE TEST BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: CYLINDRICAL GRINDER, DIAMOND DRESSER, LATHE DOG, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. DRESS WHEEL	1. MOUNT DIAMOND IN DIAMOND HOLDER 2. TURN WHEEL ONE COMPLETE REVOLUTION BY HAND TO BE SURE IT DOES NOT HIT DIAMOND OR GUARDS 3. PUT SAFETY GOGGLES ON 4. START SPINDLE NOTE: STAND TO ONE SIDE OF WHEEL TO BE SAFE IF IT SHATTERS 5. ALLOW MACHINE TO RUN FIVE MINUTES TO WARM BEARINGS 6. LOWER DIAMOND UNTIL IT TOUCHES WHEEL 7. FEED DIAMOND ACROSS WHEEL SEVERAL TIMES 8. REMOVE .002" PER CUT UNTIL WHEEL IS CLEANED UP AND SHARP 9. STOP SPINDLE 10. REMOVE DIAMOND NOTE: KEEP HANDS AWAY FROM THE GRINDING WHEEL, IT CAN CAUSE SERIOUS INJURY
2. MOUNT WORK BETWEEN CENTERS	1. MOUNT SAME AS ON ENGINE LATHE 2. BE SURE LATHE DOG DOES NOT BIND IN SLOT 3. LUBRICATE THE CENTERS WITH WHITE LEAD AND OIL OR GRAPHITE CENTER LUBE
3. SET REVERSING DOGS	1. SET ONE DOG TO REVERSE TABLE 1/2" FROM LATHE DOG

3. SET REVERSING DOGS (CON'T.)	2. SET SECOND DOG TO REVERSE TABLE AFTER WHEEL HAS PASSED END OF WORK PIECE AND BEFORE STRIKING TAILSTOCK
	3. RUN TABLE BACK AND FORTH SEVERAL TIMES TO CHECK REVERSING BY DOGS
4. SET TRAVEL SPEED	SET AT 12" PER MINUTE

SKETCHES: DRAWING #14: TEST BAR

REFERENCES: REF. #1, P. 33-5
REF. #2, PP. 566-567

TASK SHEET

JOB: CG-1
TASK: 3
PAGE: 1

TASK: GRIND WORK PIECE

JOB: MAKE TEST BAR

TRADE: MACHINIST

TOOLS AND MATERIALS: CYLINDRICAL GRINDER, LATHE DOG, 2" MICROMETERS, HONE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. FINAL ADJUSTMENTS	1. TURN HANDLE TO BRING WHEEL 1/8" FROM WORK PIECE 2. START WORK ROTATION 3. START SPINDLE 4. START COOLANT PUMP NOTE: BE SURE PLENTY OF COOLANT IS FLOWING BETWEEN WORK PIECE AND WHEEL 5. ENGAGE TABLE TRAVEL 6. SLOWLY BRING WHEEL INTO THE WORK PIECE
2. MAKE LIGHT CUT	1. REMOVE ABOUT .002" OR ENOUGH STOCK TO CLEAN UP 2. DISENGAGE TABLE TRAVEL WHEN THE WORK IS AWAY FROM WHEEL ON RIGHT END 3. TURN COOLANT PUMP OFF NOTE: WHEEL MAY BE LEFT TURNING IF CARE IS TAKEN NOT TO TOUCH IT
3. CHECK FOR TAPER	1. SELECT A 2" MICROMETER 2. CHECK DIAMETER OF WORK PIECE AT EACH END 3. ADJUST TAILSTOCK FOR TAPER IF NECESSARY
4. GRIND TO SIZE	1. REPEAT STEP 1 2. STOP MACHINE AND CHECK DIAMETER FREQUENTLY 3. CONTINUE TO GRIND UNTIL FINISHED

4.	GRIND TO SIZE (CON'T.)		DIAMETER IS 1.250" ± .0001"
		4.	DISENGAGE TABLE TRAVEL WHEN THE RIGHT END OF WORK IS AWAY FROM WHEEL
		5.	TURN COOLANT PUMP OFF
5.	GRIND OPPOSITE END	1.	REMOVE WORK PIECE FROM MACHINE
		2.	REMOVE LATHE DOG
		3.	PLACE LATHE DOG ON OPPOSITE END
		4.	PROTECT WORK FROM THE LATHE DOG SCREW
		5.	MOUNT WORK IN MACHINE
		6.	RESET REVERSING DOG ON LEFT TO ALLOW 1/2 THE GRINDING WHEEL TO EXTEND BEYOND THE SHOULDER
		7.	GRIND SHOULDER TO BLEND WITH THE FIRST CUT
		8.	HOLD TO 1.250" ± .0001"
		9.	STOP MACHINE
		10.	REMOVE WORK PIECE
6.	REMOVE BURRS		USE A HONE TO REMOVE THE GRINDING BURRS AT ENDS
7.	CLEAN MACHINE	1.	CLEAN EQUIPMENT AND RETURN TO PROPER PLACE
		2.	WIPE MACHINE CLEAN NOTE: AIR IS NOT TO BE USED IN CLEANING THE MACHINE
8.	INSPECT WORK PIECE	1.	1.250" O.D.
		2.	10" LENGTH
		3.	1/16" RADII
		4.	1/16" X 1/2" RESET

HEAT TREAT

SKETCHES: DRAWING #14: TEST BAR

REFERENCES: REF. #1, P. 33-5
REF. #2, PP. 566-567

MACHINE SHOP BENCH PLATE

SHAPER 6

SURFACE GRINDER 3

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND CONSTRUCT A BENCH PLATE ACCORDING TO SPECIFICATIONS; USING THE TOOLS, MACHINES, AND EQUIPMENT CALLED FOR IN THE JOB.

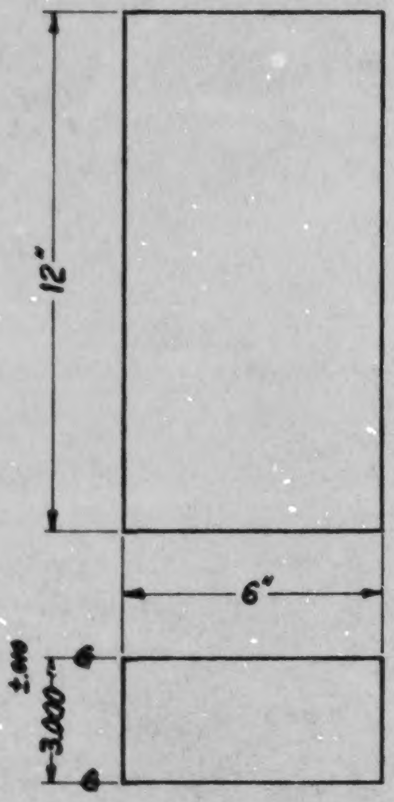
CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.



F.A.O.

NOTE: ALLOW .012-.015 FOR GRINDING

DRAWING NO. 9	BENCH PLATE	TOLERANCE CHART
SHAPER JOB NO. 6 SURFACE GRINDER JOB NO. 3	MATERIAL: CAST IRON FINISH: TOOL & GRIND SCALE: 3" = 1'-0"	FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1/2°

S-6

JOB SHEET
IN
SHAPER

JOB:	MAKE BENCH PLATE	
MATERIALS:	WORK PIECE 3 1/4" X 6 1/4" X 12 1/4" CAST IRON	
TOOLS AND EQUIPMENT:	SHAPER, SHAPER TOOL HOLDER, TOOL BIT, PARALLELS, BRASS HAMMER, MILL FILE, MICROMETER	
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 37-1 TO 37-16 AND REF. #2, PP. 499-523. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.	
PROCEDURES AND/OR TASKS:	S-6-1	CHECK MACHINE FOR PROPER RUNNING CONDITION, DRILL DRIFT, S-1-1
	S-6-2	SET UP SHAPER, T-NUT, S-2-2
	S-6-3	MACHINE WORK PIECE ON SIDES, EDGES, AND ENDS
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.	

1. PROPER MACHINE SETUP.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. SMOOTH MACHINE FINISH.
4. ALL SURFACES SQUARE AND PARALLEL TO EACH OTHER.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: S-6
TASK: 3
PAGE: 1

TASK: MACHINE WORK PIECE ON SIDES, EDGES, AND ENDS

JOB: MAKE BENCH PLATE

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, SHAPER TOOL HOLDER, TOOL BIT, MICROMETERS, 12" RULE, BRASS HAMMER, MILL FILE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. ROUGH MACHINE FIRST SIDE	1. REFER TO STEP BLOCK, S-3a-3 2. OIL SHOULD NOT BE USED ON CAST IRON 3. MAKE ONE CUT .100 OF AN INCH NOTE: WHEN MACHINING CAST IRON, THE FIRST CUT SHOULD BE DEEP ENOUGH TO GET UNDER THE SLAG OR SCALE TO AVOID DULLING THE TOOL
2. FINISH MACHINE FIRST SIDE	1. REFER TO STEP BLOCK, S-3a-3 2. MAKE ONE FINISH CUT FROM .015 TO .020 OF AN INCH NOTE: THIS WILL LEAVE FROM .005" TO .010" EXCESS METAL FOR GRINDING
3. REMOVE BURRS	1. MOUNT WORK PIECE IN BENCH VISE 2. FILE BURRS
4. MACHINE SECOND SIDE	REPEAT STEPS 1-3
5. MACHINE EDGES AND ENDS	REFER TO STEP BLOCK, S-3a-3
6. CLEAN MACHINE	REFER TO DRILL DRIFT, S-1-3
7. INSPECT	1. THICKNESS SHOULD BE .010" TO .020" OVER FINISH DIMENSION 2. USE 3"-4" MICROMETERS 3. WIDTH SHOULD BE .010" TO .020" OVER 4. USE 6" MICROMETER NOTE: EDGES WILL NOT BE GROUND 5. LENGTH SHOULD BE .010" TO .020" OVER 6. USE 12" RULE TO MEASURE LENGTH 7. FINISH SHOULD BE SMOOTH

7. INSPECT (CON'T.) 8. CLEAN WORK STATION

ROUTE TO SURFACE GRINDER

SKETCHES: DRAWING #9: BENCH PLATE

REFERENCES: REF. #1, PP. 37-1 TO 37-16
REF. #2, PP. 499-523

SG-3

JOB SHEET
IN
SURFACE GRINDER

JOB:	MAKE BENCH PLATE
MATERIALS:	WORK PIECE WITH .012" TO .015" ALLOWED ON BOTH SURFACES FOR GRINDING
TOOLS AND EQUIPMENT:	SURFACE GRINDER, GRINDING WHEEL, MAGNETIC CHUCK, DIAMOND DRESSER, 3" MICROMETER, SLIP STONE
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 33-1 TO 33-14 AND REF. #2, PP. 565-581. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.
PROCEDURES AND/OR TASKS:	SG-3-1 CHECK MACHINE FOR PROPER RUNNING CONDITION, PARALLEL BLOCKS, SG-1-1 SG-3-2 SET UP MACHINE FOR GRINDING, PARALLEL BLOCKS, SG-1-2 SG-3-3 GRIND WORK PIECE
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. ELECTROMAGNET HOLDING POWER.
2. CORRECT SETUP.
3. GRINDING WHEEL SHARP AND FREE OF CRACKS OR FLAWS.
4. ALL DIMENSIONS HELD TO SPECIFICATIONS.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: SG-3
TASK: 3
PAGE: 1

TASK:	GRIND WORK PIECE
JOB:	MAKE BENCH PLATE
TRADE:	MACHINIST
TOOLS AND MATERIALS:	SURFACE GRINDER, GRINDING WHEEL, MAGNETIC CHUCK, DIAMOND DRESSER, 3" MICROMETER, SLIP STONE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. GRIND FIRST SIDE	1. REFER TO PARALLEL BLOCKS, SG-1-3 2. GRIND TO MINIMUM CLEAN UP
2. GRIND SECOND SIDE	1. REPEAT STEP 1 2. HOLD 3.000" ± .010
3. CLEAN UP	1. REMOVE PLATE 2. CLEAN AND RETURN EQUIPMENT TO PROPER PLACE 3. CLEAN MACHINE THOROUGHLY NOTE: AIR IS NOT TO BE USED AS IT WILL BLOW PARTICLES OF ROCK AND GRINDING DUST INTO MACHINE WAYS
4. REMOVE BURRS	RUB ALL EDGES WITH SLIP STONE NOTE: HARDENED MATERIAL SHOULD NOT BE FILED
5. INSPECT	1. THICKNESS-3.000" ± .010" NOTE: CHECK SEVERAL PLACES 2. FINISH-SMOOTH

SKETCHES: DRAWING #9: BENCH PLATE

REFERENCES: REF. #1, PP. 33-1 TO 33-14
REF. #2, PP. 565-581

MACHINE SHOP

LIMIT GAUGE

BENCH WORK	9
DRILL PRESS	6
MILLING	HM-5
SURFACE GRINDER	4
HEAT TREAT	3

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWINGS, AND CONSTRUCT A LIMIT GAUGE ACCORDING TO SPECIFICATIONS; USING THE TOOLS, EQUIPMENT, MACHINES, AND MATERIAL CALLED FOR IN THE JOB.

CHECKING STANDARDS

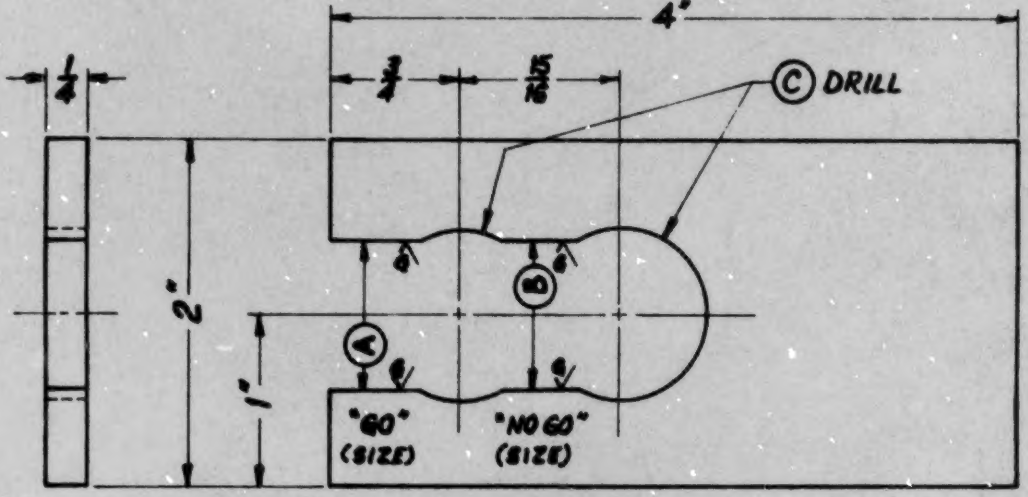
1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK. MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.

NOTE: THE TASK SHEETS ARE DESIGNED FOR REF. #1 ON DRAWING #10. IF OTHER SIZES ARE DESIRED, DIMENSIONS MUST BE CHANGED ACCORDINGLY.



ALLOW .012
FOR GRINDING

STAMP GO & NO GO SIZE ON PLATE

CARBURIZE & HARDEN

REF NO.	A	B	C
1	$.501^{+.0001}_{-.0001}$	$.499^{+.0001}_{-.0001}$	5/8
2	$.626^{+.0001}_{-.0001}$	$.624^{+.0001}_{-.0001}$	3/4
3	$.751^{+.0001}_{-.0001}$	$.749^{+.0001}_{-.0001}$	7/8
4	$.876^{+.0001}_{-.0001}$	$.874^{+.0001}_{-.0001}$	1

DRAWING NO. 10	LIMIT GAUGE	TOLERANCE CHART
BENCH JOB NO. 7 MILLING JOB NO. 5 SURFACE GRIND JOB NO. 4	MATERIAL: MILD STEEL FINISH: FILE & GRIND SCALE: FULL SIZE	FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1/2°

B-9a

JOB SHEET
IN
BENCH WORK

JOB:	MAKE LIMIT GAUGE
MATERIALS:	WORK PIECE 1/4" X 2" X 4 1/8" FLAT MILD STEEL
TOOLS AND EQUIPMENT:	BENCH VISE, LAYOUT EQUIPMENT, COMBINATION SQUARE, ADJUSTABLE PARALLEL, HAMMER, CENTER PUNCH
GENERAL INSTRUCTIONS:	CHECK DRAWING FOR ALL SPECIFICATIONS BEFORE STARTING JOB. CHECK WITH INSTRUCTOR AFTER TOOLS AND MATERIALS HAVE BEEN ASSEMBLED FOR LAST MINUTE INSTRUCTIONS.
PROCEDURES AND/OR TASKS:	B-9a-1 OBTAIN MATERIAL FROM POWER HACKSAW, CLAMP STRAP, PH-1 B-9a-2 SQUARE ENDS TO HOLD 4" LENGTH, CLAMP STRAP, B-1a-1 B-9a-3 LAYOUT AND CENTER PUNCH
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. ENDS SQUARE AND PARALLEL.
2. LAYOUT LINES AND PUNCH MARKS TO SPECIFICATIONS.
3. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: B-9a
TASK: 3
PAGE: 1

TASK: LAYOUT AND CENTER PUNCH
JOB: MAKE LIMIT GAUGE
TRADE: MACHINIST
TOOLS AND MATERIALS: COMBINATION SQUARE, SCRIBE, CENTER PUNCH, HAMMER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LAYOUT HOLES	1. SET COMBINATION SQUARE HEAD ON 1" 2. POSITION SQUARE HEAD ON EDGE OF PART 3. SCRIBE A CENTER LINE 2" DOWN PART 4. SET SQUARE ON 3/4" 5. POSITION SQUARE HEAD ON END 6. SCRIBE A LINE ACROSS CENTER LINE 7. SET SQUARE ON 1 11/16" (3/4" + 15/16") 8. SCRIBE SECOND LINE ACROSS CENTER LINE 9. THE TWO INTERSECTIONS ARE CENTERS FOR HOLES
2. LAYOUT DIMENSIONS "A" AND "B"	1. SET COMBINATION SQUARE ON 3/4" 2. POSITION SQUARE HEAD ON ONE EDGE OF LAID OUT PART 3. SCRIBE ONE SIDE OF DIMENSION "A" AND "B" 4. REPEAT ON OPPOSITE EDGE
3. CENTER PUNCH HOLES	1. HOLD PUNCH FIRMLY IN HAND AND PERPENDICULAR TO WORK 2. HAVE PUNCH HEAD AT LEAST 1/2" ABOVE HEAD 3. PLACE POINT ON INTERSECTION LAYOUT FOR FIRST HOLE 4. TAP PUNCH HEAD GENTLY WITH HAMMER 5. REPEAT THE STEP FOR SECOND HOLE

ROUTE TO DRILL PRESS

SKETCHES: DRAWING #10: LIMIT GAUGE

REFERENCES: REF. #1, PP. 6-1 TO 6-10
REF. #2, PP. 62-66 AND PP. 215-216

DP-6

JOB SHEET
IN
DRILL PRESS

JOB:	MAKE LIMIT GAUGE
MATERIALS:	WORK PIECE 1/4" X 2" X 4 1/8" FLAT MILD STEEL LAID OUT AND CENTER PUNCHED FOR DRILLING
TOOLS AND EQUIPMENT:	DRILL PRESS, DRILL PRESS VISE, DRILL DRIFT, 5/8" TAPER SHANK DRILL, PARALLELS, MILL FILE
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 34-1 TO 34-24 AND REF. #2, PP. 203-228. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.
PROCEDURES AND/OR TASKS:	DP-6-1 CHECK THE DRILL PRESS FOR OPERATION, CLAMP STRAP, DP-1-1 DP-6-2 DRILL HOLES, CLAMP STRAP, DP-1-3
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK. 1. DRILL PRESS IN PROPER WORKING ORDER. 2. CORRECT SETUP FOR DRILLING 5/8" HOLES. 3. 5/8" HOLES DRILLED TO SPECIFICATION. 4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

B-9b

JOB SHEET
IN
BENCH WORK

JOB:	MAKE LIMIT GAUGE
MATERIALS:	WORK PIECE 1/4" X 2" X 4 1/8" FLAT MILD STEEL PROPERLY LAID OUT AND DRILLED
TOOLS AND EQUIPMENT:	BENCH VISE, HAND HACKSAW, 10" MILL FILE, 1/8" STEEL LETTERS AND FIGURES
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 9-1 TO 9-5 AND REF. #2, PP. 84-89. CHECK WITH INSTRUCTOR AT FREQUENT INTERVALS.
PROCEDURES AND/OR TASKS:	B-9b-1 HAND SAW SLOT, CLAMP STRAP, B-1b-1 B-9b-2 FILE SLOT TO HOLD "A" AND "B" DIMENSIONS B-9b-3 STAMP WORK PIECE
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK. 1. PROPER USE OF HAND HACKSAW. 2. PROPER USE OF FILE. 3. VISIBLE STAMP MARKS. 4. DIMENSIONS HELD TO SPECIFICATIONS. 5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: B-9b
TASK: 2
PAGE: 1

TASK: FILE SLOT TO HOLE "A" AND "B" DIMENSIONS

JOB: MAKE LIMIT GAUGE

TRADE: MACHINIST

TOOLS AND MATERIALS: BENCH VISE, 10" MILL FILE, ADJUSTABLE PARALLEL, MICROMETER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK	1. OPEN BENCH VISE 1" 2. PLACE WORK IN VISE a. PARALLEL TO BENCH b. SLOT EXPOSED c. BOTTOM FINISH LINE SLIGHTLY ABOVE VISE JAWS 3. PROTECT WORK 4. TIGHTEN VISE
2. FILE ONE SIDE OF SLOT "A" AND "B"	1. USE 10" MILL FILE WITH HANDLE 2. KEEP FILE SURFACE SQUARE TO SIDES OF WORK PIECE 3. FILE TO LAYOUT LINE 4. LOOSEN VISE AND REMOVE WORK PIECE
3. FILE SECOND SIDE OF SLOT "A"	1. TURN WORK PIECE OVER 2. REPEAT STEP 1 3. CHECK WIDTH OF SLOT WITH ADJUSTABLE PARALLEL AND MICROMETER BEFORE FILING NOTE: THERE IS A TOTAL TOLERANCE OF ONLY .0002" 4. REPEAT STEP 2 5. HOLD SLOT .501 ± .0001" 6. MAKE FREQUENT CHECKS ON WIDTH DURING FILING 7. KEEP SIDE OF SLOT SQUARE WITH FLAT SURFACES AND PARALLEL TO OTHER SIDE OF SLOT
4. FILE SECOND SIDE OF SLOT "B"	1. REPEAT STEP 3 2. HOLD SLOT TO .499 ± .0001"

5. FILE CHAMFER	FILE LIGHT CHAMFER ON ALL EDGES OF WORK PIECE TO BREAK SHARP EDGES AND CORNERS
6. CLEAN UP	1. CLEAN FILE AND RETURN TO PROPER PLACE 2. COLLECT AND DISPOSE OF FILINGS
7. INSPECT	1. DIMENSION "A" 2. DIMENSION "B" 3. LENGTH

SKETCHES: DRAWING #10: LIMIT GAUGE

REFERENCES: REF. #1, PP. 17-1 TO 17-7
REF. #2, PP. 113-117

TASK SHEET

JOB: B-9b
TASK: 3
PAGE: 1

TASK: STAMP WORK PIECE
JOB: MAKE LIMIT GAUGE
TRADE: MACHINIST
TOOLS AND MATERIALS: 1/8" STEEL LETTERS AND FIGURES, HAMMER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP TO STAMP WORK PIECE	1. WIPE TABLE CLEAN WITH HAND 2. LAY WORK PIECE FLAT ON TABLE 3. SELECT 1/8" STEEL STENCILS "G", "O", "N"
2. STAMP GO	1. LOCATE THE "G" STENCIL 1/4" BELOW SLOT "A" NOTE: IF STENCIL IS PLACED TOO CLOSE TO SLOT, METAL WILL MOVE CAUSING DIMENSION "A" TO BE UNDERSIZE 2. HOLD STENCIL PERPENDICULAR TO WORK PIECE 3. HIT STENCIL FIRMLY WITH HAMMER TO MAKE A CLEAR IMPRESSION IN WORK PIECE 4. REPEAT USING STENCIL "O" ON RIGHT SIDE OF THE "G" TO FORM WORK "GO"
3. STAMP NO GO	1. LOCATE THE "N" STENCIL BELOW SLOT "B" 2. STAMP "N" IN WORK PIECE 3. FOLLOW "N" WITH "O" IN SAME MANNER FORMING WORD "NO" 4. SKIP A SPACE 5. STAMP "GO" IN SAME MANNER FOLLOWING "NO"
4. STAMP SLOT SIZE	1. SELECT STENCILS WITH FIGURES 5, 0, 1, 4, AND 9 2. STAMP NUMBERS 501 UNDER "GO" 3. STAMP 499 UNDER "NO GO"

4. STAMP SLOT SIZE (CON'T.)	4. SELECT STENCIL WITH A PERIOD 5. STAMP A PERIOD BEFORE .501 AND .499
5. ROUTE TO HEAT TREAT	HEAT TREAT AS IN PARALLEL BLOCKS, HT-1

SKETCHES: DRAWING #10: LIMIT GAUGE

REFERENCES: REF. #2, PP. 431-433

JOB SHEET
IN
MILLING

OPTIONAL HM-6

JOB:	MAKE LIMIT GAUGE	
MATERIALS:	WORK PIECE 1/4" X 2" X 4 1/8" FLAT MILD STEEL PROPERLY LAID OUT AND DRILLED	
TOOLS AND EQUIPMENT:	MILLING MACHINE, MILLING MACHINE VISE, ARBOR, SPACING COLLARS, 3/16" X 6" SLITTING SAW, FLAT MILL FILE	
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 38-1 TO 38-37 AND REF. #2, PP. 524-564	
PROCEDURES AND/OR TASKS:	HM-6-1	CHECK MACHINE FOR PROPER RUNNING CONDITION, T-NUT, HM-1-1
	HM-6-2	SET UP HORIZONTAL MILLING MACHINE, T-NUT, HM-1-3 NOTE: MOUNT SAW IN PLACE OF HELICAL MILL CUTTER
	HM-6-3	MACHINE WORK PIECE
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.	

1. PROPER MACHINE SETUP.
2. OIL RESERVOIRS FILLED TO PROPER LEVEL.
3. ALL DIMENSIONS HELD TO SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: HM-6
TASK: 3
PAGE: 1

TASK: MACHINE WORK PIECE

JOB: MAKE LIMIT GAUGE

TRADE: MACHINIST

TOOLS AND MATERIALS: MILLING MACHINE, MILLING MACHINE VISE, ARBOR, SPACING COLLARS, WORK PIECE, FLAT MILL FILE, 3/16" X 6" SLITTING SAW

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION SAW FOR FIRST CUT	1. MOVE TABLE UNTIL CUTTER IS OVER WORK PIECE AND BETWEEN LAYOUT LINES 2. MOVE TABLE OUT UNTIL INSIDE EDGE OF CUTTER IS .010" TO .020" FROM LAYOUT LINE
2. SET FEED AND SPEED	1. SET SLOW FEED OF 1/8" TO 1/4" PER MINUTE 2. SET MACHINE SPEED TO 60' PER MINUTE
3. SAW FIRST SIDE	1. PUT SAFETY GOGGLES ON 2. START MACHINE 3. RAISE TABLE UNTIL SAW BEGINS TO CUT 4. TURN OIL PUMPS ON 5. ENGAGE AUTOMATIC FEED 6. FEED UP 1 1/2" FROM STARTING POINT NOTE: SAW SHOULD NOT TOUCH SIDE OF HOLE
4. POSITION SAW FOR SECOND CUT	1. LOWER TABLE 2" FROM WHERE LAST CUT STOPPED 2. MOVE TABLE IN AND UP TO POSITION CUTTER AS IN STEP 1
5. SAW SECOND SIDE	1. REPEAT STEP 3 2. STOP MACHINE 3. REMOVE WORK PIECE
6. REMOVE BURRS	1. HOLD PART IN ONE HAND

6.	REMOVE BURRS (CON'T.)	2.	FILE A SMALL CHAMFER ON ALL EDGES AND CORNERS
7.	CLEAN MACHINE	1.	REMOVE SLITTING SAW RETURN TO PROPER PLACE
		2.	REMOVE ARBOR, CLEAN AND STORE
		3.	REMOVE ALL CHIPS WITH BRUSH
		4.	WIPE MACHINE CLEAN
		5.	DISPOSE OF WASTE

ROUTE TO SURFACE GRINDER

SKETCHES: DRAWING #10: LIMIT GAUGE

REFERENCES: REF. #1, PP. 38-1 TO 38-38
REF. #2, PP. 524-564

SG-5

JOB SHEET
IN
SURFACE GRINDER

JOB: MAKE LIMIT GAUGE

MATERIALS: ONE LIMIT GAUGE, HARDENED WITH STOCK LEFT FOR GRINDING

TOOLS AND EQUIPMENT: SURFACE GRINDER, MAGNETIC CHUCK, ANGLE PLATE, DIAMOND DRESSER OR ABRASIVE STICK, COMBINATION SQUARE, TOOLMAKER'S CLAMP OR 2" "C" CLAMP, GAUGE BLOCKS

GENERAL INSTRUCTIONS:

SG-5-1 CHECK MACHINE FOR PROPER RUNNING CONDITIONS, JOB SG-1-1
SG-5-2 SET UP MACHINE FOR GRINDING
SG-5-3 GRIND WORK PIECE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK ELECTROMAGNETIC HOLDING POWER, PARALLEL BLOCKS, SG-1-1
2. CORRECT SETUP, PARALLEL BLOCKS, SG-1-2.
3. GRINDING WHEEL SHARP AND FREE OF CRACKS OR FLAWS, PARALLEL BLOCKS, SG-1-3.
4. ALL DIMENSIONS HELD TO SPECIFICATIONS.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: SG-5
TASK: 2
PAGE: 1

TASK: SET UP MACHINE FOR GRINDING

JOB: MAKE LIMIT GAUGE

TRADE: MACHINIST

TOOLS AND MATERIALS: SURFACE GRINDER, MAGNETIC CHUCK, ANGLE PLATE, DIAMOND DRESSER OR ABRASIVE STICK, COMBINATION SQUARE, TOOLMAKER'S CLAMP OR 2" "C" CLAMP, GAUGE BLOCKS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SELECT PROPER WHEEL	1. DISH WHEEL 2. SHOULD CORRESPOND TO NORTON #3846 H5 BE
2. MOUNT WHEEL	1. SAME AS PARALLEL BLOCKS, SG-1-2 2. CONCAVE SIDE OF WHEEL OUT
3. DRESS WHEEL	1. PUT SAFETY GOGGLES ON 2. TURN MACHINE ON NOTE: STAND ASIDE AND ALLOW THE WHEEL TO RUN FOR 1/2 MINUTE TO CHECK 3. USE DIAMOND DRESSER OR ABRASIVE STICK TO DRESS WHEEL 4. DRESS BOTH PERIPHERY AND EDGE OF CONCAVE SIDE 5. TURN MACHINE OFF
4. CLEAN CHUCK	1. CLEAN CHUCK WITH RAG 2. WIPE CHUCK WITH PALM OF HAND
5. SET UP ANGLE PLATE	1. PLACE ON CHUCK PARALLEL TO SPINDLE 2. TURN ELECTROMAGNETIC CHUCK ON 3. ATTACH DIAL INDICATOR TO HORIZONTAL ARM 4. INDICATE FACE OF ANGLE PLATE TRUE
6. SET UP WORK PIECE	1. CLEAN BOTH SIDES OF WORK PIECE WITH HANDS 2. PLACE FLAT SIDE OF WORK PIECE AGAINST FACE OF ANGLE PLATE WITH

6. SET UP WORK PIECE (CON'T.)	SLOT UP 3. CLAMP WORK PIECE TO ANGLE PLATE 4. SQUARE ONE EDGE OF WORK PIECE WITH COMBINATION SQUARE NOTE: PLACE SQUARE HEAD ON ANGLE PLATE AND RULE AGAINST SIDE OF WORK PIECE
7. POSITION WHEEL	1. MOVE TABLE TO BRING WHEEL INSIDE SLOT 2. PLACE BOTTOM OF DISH WHEEL BELOW BOTTOM OF SIDE "B" ON DRAWING 3. SET TABLE TRAVEL TO PASS 1/2" OFF WORK PIECE ON EACH END

SKETCHES: DRAWING #10: LIMIT GAUGE

REFERENCES: REF. #2, PP. 410-411

TASK SHEET

JOB: SG-5
TASK: 3
PAGE: 1

TASK: GRIND WORK PIECE

JOB: MAKE LIMIT GAUGE

TRADE: MACHINIST

TOOLS AND MATERIALS: SURFACE GRINDER, MAGNETIC CHUCK, DIAMOND DRESSER OR ABRASIVE STICK, ANGLE PLATE, COMBINATION SQUARE, TOOLMAKER'S CLAMP OR 2" "C" CLAMP, GAUGE BLOCKS, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. GRIND FIRST SIDE	1. PUT SAFETY GOGGLES ON 2. TURN MACHINE ON 3. ENGAGE TABLE TRAVEL 4. MOVE TABLE IN UNTIL WHEEL BEGINS TO TOUCH WORK PIECE 5. REMOVE .002" PER CUT UNTIL .010" TO .015" HAS BEEN REMOVED NOTE: GRIND ONE SIDE OF BOTH SLOT "A" AND "B" 6. TURN MACHINE OFF
2. REVERSE WHEEL	1. REMOVE DISH WHEEL 2. REMOUNT WITH CONCAVE SIDE FACING INSIDE 3. TIGHTEN SPINDLE NUT
3. DRESS WHEEL	DRESS WHEEL AS IN TASK 2 NOTE: ANY TIME WHEEL IS PLACED ON SPINDLE IT IS TO BE DRESSED TRUE
4. GRIND SECOND SIDE OF SLOT	1. USE SAME PROCEDURE AS IN STEP 1 2. HOLD DIMENSION "B" TO "A" FINISH SIZE OF .499" ± .0001 NOTE: MAKE FREQUENT CHECKS WITH JO OR GAUGE BLOCKS SET TO MAXIMUM TOLERANCE NOTE: WHEN DIMENSION "B" HAS BEEN FINISHED THERE WILL BE .002" OF MATERIAL TO BE REMOVED FROM DIMENSION "A"

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5. FINISH GRIND DIMENSION "A"	1. RAISE GRINDING WHEEL UNTIL THE BOTTOM IS ABOVE DIMENSION "B" AND STILL COVERS DIMENSION "A" 2. GRIND SECOND SIDE OF DIMENSION "A" AS IN STEP 4 3. HOLD .501" ± .0001" USING THE GAUGE BLOCKS TO CHECK 4. TURN MACHINE OFF 5. REMOVE WORK PIECE
6. REMOVE BURRS	RUB EDGES LIGHTLY WITH A HONE
7. CLEAN UP	1. REMOVE GRINDING WHEEL AND STORE 2. REMOVE ANGLE PLATE CLEAN AND STORE 3. RETURN "C" CLAMP TO PROPER PLACE 4. CLEAN MACHINE THOROUGHLY NOTE: AIR IS NOT TO BE USED, IT WILL BLOW PARTICLES OF ROCK AND GRINDING DUST INTO MACHINE WAYS
8. INSPECT	1. LENGTH-WIDTH 2. DIMENSION "A" 3. DIMENSION "B" 4. DIAMETER OF HOLES 5. FINISH

SKETCHES: DRAWING #10: LIMIT GAUGE

REFERENCES: REF. #1, PP. 33-1 TO 33-14
REF. #2, PP. 565-581

MACHINE SHOP STEEL WASHERS

TURRET LATHE 1

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWINGS, AND CONSTRUCT STEEL WASHERS ACCORDING TO SPECIFICATIONS; USING THE TOOLS, MACHINES, EQUIPMENT, AND MATERIALS CALLED FOR IN THE JOB.

CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

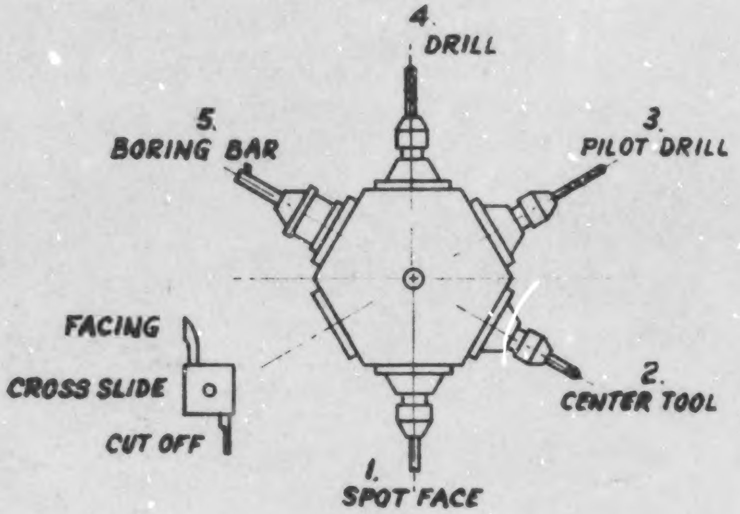
REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

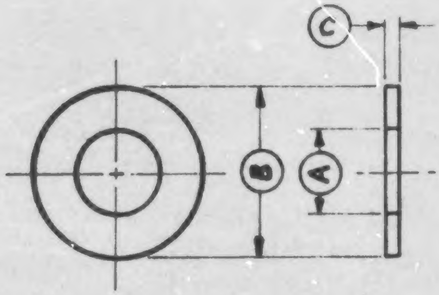
REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.

NOTE: THE TASK SHEETS FOR THIS JOB ARE DESIGNED FOR REF. #1 ON DRAWING #11. IF OTHER SIZES ARE DESIRED, DIMENSIONS MUST BE CHANGED ACCORDINGLY.

THE NUMBER OF WASHERS MACHINED IN ANY ONE SIZE IS LEFT TO THE DISCRETION OF THE INSTRUCTOR.


4. DRILL
5. BORING BAR
3. PILOT DRILL
FACING
CROSS SLIDE
CUT OFF
2. CENTER TOOL
1. SPOT FACE

TOOL LAYOUT



REF. NO.	BOLT SIZE	A	B	C
1	1/4	5/16	3/4	1/16
2	5/16	3/8	7/8	1/16
3	3/8	7/16	1	5/64
4	7/16	1/2	1 1/4	5/64
5	1/2	9/16	1 3/8	7/64

DRAWING NO. 11	STEEL WASHERS	TOLERANCE CHART
TURRET LATHE JOB NO. 1	MATERIAL: C.R. STEEL FINISH: TOOL SCALE: NONE	FRACTIONS ±1/64 DECIMALS ±.005 ANGLES ±1/2°

JOB SHEET
IN
TURRET LATHE

TL-1

JOB:	MAKE STEEL WASHERS	
MATERIALS:	ONE BAR OF ROUND 3/4" COLD ROLLED STEEL	
TOOLS AND EQUIPMENT:	TURRET LATHE, CROSS SLIDE, TOOL HOLDER, TURRET STOCK STOP, CENTERING TOOL, DRILL, DRILL HOLDER, 3/4" COLLET, FEED FINGERS, CUT OFF TOOL, MILL FILE	
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #1, PP. 36-39. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.	
PROCEDURES AND/OR TASKS:	TL-1-1	CHECK TURRET LATHE FOR PROPER RUNNING CONDITION
	TL-1-2	SET UP TURRET LATHE
	TL-1-3	MACHINE WORK
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.	

1. CHECK MATERIAL SUPPORT IF LONG BAR IS USED.
2. CHECK COOLANT TANK FOR PROPER LEVEL.
3. CHECK OIL RESERVOIRS FOR PROPER LEVEL.
4. CHECK MACHINE SETUP.
5. ALL DIMENSIONS HELD TO SPECIFICATIONS.
6. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: TL-1
TASK: 1
PAGE: 1

TASK: CHECK TURRET LATHE FOR PROPER RUNNING CONDITION

JOB: MAKE STEEL WASHERS

TRADE: MACHINIST

TOOLS AND MATERIALS: TURRET LATHE, CROSS SLIDE, TOOL HOLDER, TURRET STOCK STOP, CENTERING TOOL, DRILL, DRILL HOLDER, 3/4" COLLET, FEED FINGERS, CUT OFF TOOL, OIL, CLEAN RAG.

TASK BREAKDOWN:

STEPS	KEY POINTS
1. OIL	1. CHECK COOLANT RESERVOIR TO BE SURE IT IS FILLED TO OPERATING LEVEL 2. PLACE OIL IN ALL OIL CAPS 3. APPLY LIGHT FILM OF OIL TO WAYS
2. TURRET	1. TURRET ROTATES OR INDEXES PROPERLY 2. TOOL POST TURRET REVOLVES PROPERLY
3. CROSS SLIDE	NO SLACK OR PLAY
4. MATERIAL SUPPORT AND FEED FINGERS	1. MATERIAL SUPPORT PROPERLY LOCATED 2. FEED FINGERS OPERATE PROPERLY
5. GUARDS	1. ALL GUARDS IN PROPER POSITION 2. CHECK SPLASH GUARD NOTE: SPLASH GUARD MAY BE REMOVED DURING SETUP. SPLASH GUARD MUST BE REPLACED BEFORE STARTING TO WORK.
6. COLLET CHUCK	1. INSTALLED PROPERLY 2. IN GOOD WORKING ORDER

TASK SHEET

JOB: TL-1
TASK: 2
PAGE: 1

TASK:	SET UP TURRET LATHE
JOB:	MAKE STEEL WASHERS
TRADE:	MACHINIST
TOOLS AND MATERIALS:	TURRET LATHE, CROSS SLIDE, TOOL HOLDER, CENTERING TOOL, TURRET STOCK STOP, DRILL, DRILL HOLDER, 3/4" COLLET, FEED FINGERS, CUT OFF TOOL

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT COLLET IN CHUCK	1. SELECT 3/4" COLLET 2. INSERT COLLET INTO COLLET CHUCK 3. HAND SCREW DRAW BAR INTO COLLET NOTE: THE COLLET SHOULD NOT BE TIGHTENED
2. SET UP MATERIAL	1. SELECT BAR OF 3/4" COLD ROLLED STEEL 2. FEED BAR STOCK THROUGH THE STOCK SUPPORT 3. FEED BAR STOCK THROUGH SPINDLE 4. ALLOW STOCK TO EXTEND 2" BEYOND COLLET 5. TIGHTEN COLLET DRAW BAR ONLY ENOUGH TO SECURE THE WORK FOR MACHINING
3. SET STOCK STOP	1. MOUNT STOCK STOP ON TURRET FACE #1 2. TIGHTEN BOLTS TO SECURE STOCK STOP 3. SET THE REVOLVING TURRET STOP #1 WHERE END OF STOCK STOP IS 2" FROM FACE OF COLLET
4. SET UP CENTER DRILL	1. SELECT SHARP CENTER DRILL 2. MOUNT CENTER DRILL ON TURRET FACE #2 3. TIGHTEN BOLTS TO SECURE CENTER DRILL IN PLACE NOTE: HOW DRILL IS HELD DEPENDS

	UPON TYPE OF TURRET BEING USED 4. SET THE REVOLVING TURRET STOP #2 WHERE ANGLE OF DRILL IS 2" FROM FACE OF COLLET
5. SET UP PILOT DRILL	1. PILOT DRILL WILL NOT BE USED FOR REF. #1 2. PILOT HOLES USED FOR LARGER HOLES
6. SET UP DRILL	1. SELECT SHARP 5/16" DRILL 2. MOUNT DRILL ON TURRET FACE #3 3. SET REVOLVING STOP #3 UNTIL POINT OF DRILL IS 1 3/4" FROM FACE OF THE COLLET
7. SET UP BORING BAR	1. THE BORING BAR WILL NOT BE NEEDED FOR REF. #1 2. USED FOR LARGE HOLES NOTE: IT IS NOT NECESSARY TO USE THE BORING BAR FOR ANY OF THE REFERENCE NUMBERS IN DRAWING 11 NOTE: IT MAY BE NECESSARY TO SET SOME OR ALL STOPS AFTER THE FIRST PART HAS BEEN RUN
8. SET UP FACING TOOL	1. SELECT A SHARP FACING TOOL 2. MOUNT FACING TOOL IN TOOL POST TURRET NOTE: CHECK DIAGRAM IN DRAWING 3. TIGHTEN SET SCREWS TO SECURE TOOL IN POSITION 4. LOCATE POINT OF FACING TOOL ON CENTER LINE OF WORK PIECE 5. USE SHIM STOCK UNDER TOOL IF NECESSARY 6. SET STOP TO ALLOW TOOL TO REMOVE 1/32" MATERIAL FROM END OF WORK PIECE 7. CHECK AFTER FIRST CUT AND RESET IF NECESSARY
9. SET UP PARTING TOOL	1. SELECT A SHARP PARTING (CUT OFF) TOOL 2. MOUNT PARTING TOOL IN TOOL POST TURRET 3. TIGHTEN SET SCREWS

9. SET UP PARTING TOOL (CON'T.)	4. LOCATE POINT OF TOOL ON CENTER LINE OF WORK PIECE
	5. USE SHIM STOCK UNDER TOOL IF NECESSARY
	6. SET STOPS TO PART WORK PIECE 1/16" FROM END AFTER FACING
	7. RESET STOP AFTER FIRST CUT IF NECESSARY
10. SET FEED AND SPEED	1. SET CROSS FEED TO REMOVE .002" PER REVOLUTION
	2. SET SPEED AT 400 RPM
	3. REPLACE SPLASH GUARDS REMOVED DURING MACHINE SETUP

SKETCHES: DRAWING #11: STEEL WASHERS

REFERENCES: REF. #1, PP. 36-39

TASK SHEET

JOB: TL-1
TASK: 3
PAGE: 1

TASK:	MACHINE WORK
JOB:	MAKE STEEL WASHERS
TRADE:	MACHINIST
TOOLS AND MATERIALS:	TURRET LATHE, CROSS SLIDE, TOOL HOLDER, CENTERING TOOL, TURRET STOCK STOP, DRILL, DRILL HOLDER, 3/4" COLLET, FEED FINGERS, CUT OFF TOOL, MILL FILE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. FACE MATERIAL	1. PUT SAFETY GOGGLES ON 2. START THE MACHINE 3. POSITION TOOL POST WITH FACING TOOL SET FOR FACING 4. HOLD CARRIAGE AGAINST STOP 5. ENGAGE CROSS FEED LEVER NOTE: IF A POINT REMAINS IN CENTER OF WORK PIECE, PLACE SHIM STOCK UNDER THE TOOL TO RAISE TO PROPER HEIGHT
2. CENTER DRILL	1. POSITION TURRET TO CENTER DRILL 2. CENTER DRILL TO STOP
3. DRILL	1. POSITION TURRET TO DRILL 2. DRILL HOLE TO STOP
4. REMOVE BURRS	1. LEAVE MACHINE RUNNING 2. FILE INSIDE AND OUTSIDE EDGE OF HOLE LIGHTLY
5. PART WORK	1. POSITION TOOL POST WITH PARTING TOOL SET TO CUT WORK PIECE 2. ENGAGE CROSS FEED LEVER 3. HOLD CARRIAGE AGAINST STOP NOTE: IF CHATTER OCCURS REDUCE SPEED BY 1/2 4. WHILE PARTING TOOL IS MAKING ITS CUT, LAY A FILE ON EDGE OF WASHER TO REMOVE SHARP EDGE NOTE: CONTINUE MAKING WASHERS

5. PART WORK (CON'T.)		UNTIL REQUIRED NUMBER HAS BEEN REACHED
6. REMOVE BURRS		FILE BURRS LEFT ON HOLES NOTE: SOME SHOPS ARE EQUIPPED WITH A TUMBLER FOR REMOVING THE BURRS
7. CLEAN MACHINE	1.	REMOVE, CLEAN, AND STORE TOOLS
	2.	REMOVE CHIPS WITH BRUSH
	3.	WIPE MACHINE
	4.	DISPOSE OF WASTE
8. INSPECT	1.	A- .312"
	2.	B- 3/4"
	3.	C- 1/16"

SKETCHES: DRAWING #11: STEEL WASHERS

REFERENCES: REF. #1, PP. 36-39

MACHINE SHOP LAPPING PLATE

SHAPER	7
MILLING	HM-6
SURFACE GRINDER	5

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWINGS, AND CONSTRUCT A LAPPING PLATE ACCORDING TO SPECIFICATIONS, USING TOOLS, EQUIPMENT, MACHINES, AND MATERIALS CALLED FOR IN THE JOB.

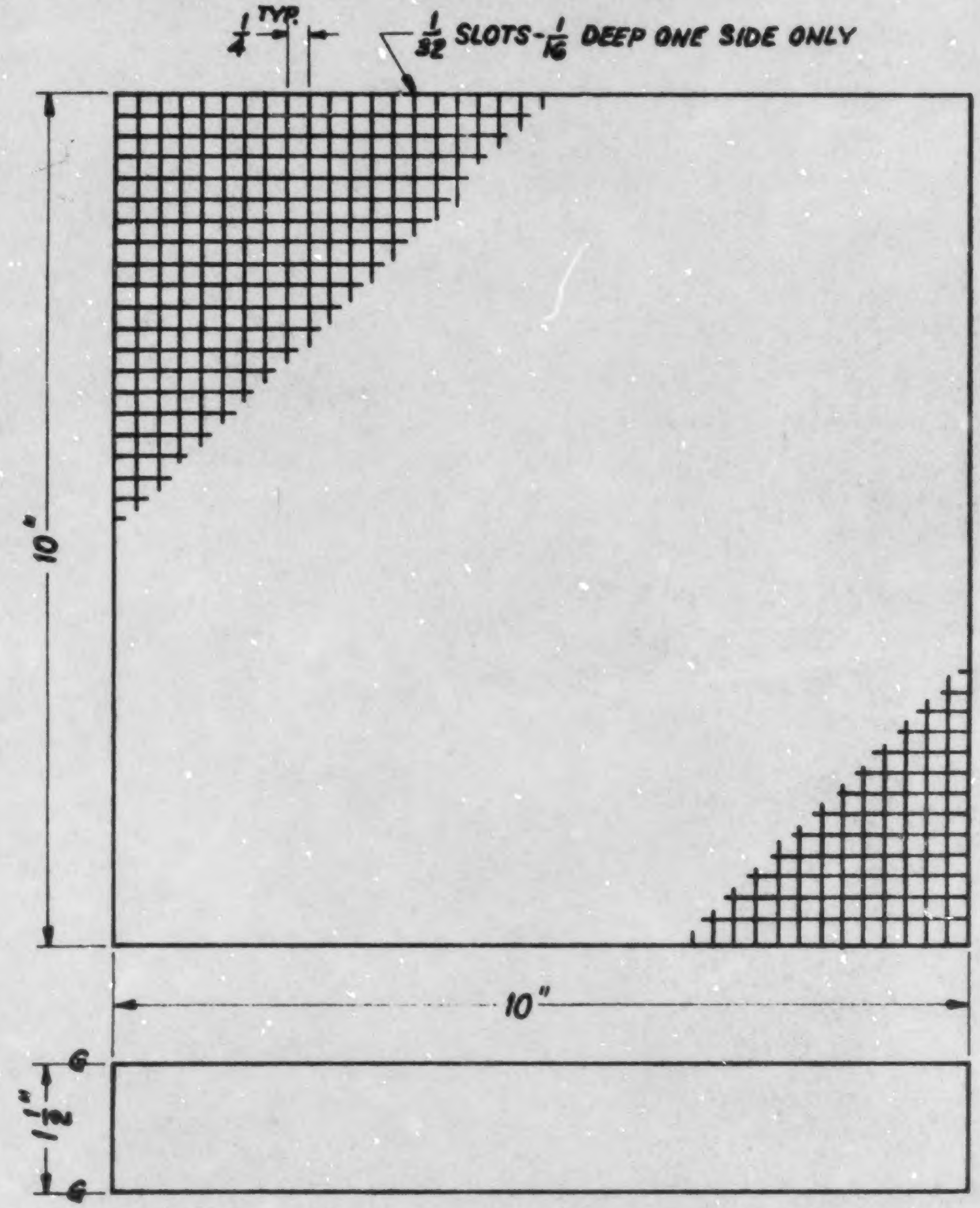
CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.


1/4 TYP.
1/32 SLOTS-1/16 DEEP ONE SIDE ONLY
10"
10"
G
1 1/2"
G

F.A.O.

ALLOW .020 FOR GRINDING

DRAWING NO. 12	LAPPING PLATE	TOLERENCE CHART
SHAPER JOB NO. 7 MILLING JOB NO. 6 SURFACE GRINDER JOB NO. 5	MATERIAL: CAST IRON FINISH: TOOL & GRIND SCALE: HALF SCALE	FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1/2°

JOB SHEET
IN
SHAPER

S-7

JOB: MAKE LAPPING PLATE

MATERIALS: ONE PIECE 10 1/4" X 10 1/4" X 1 3/4" ROUGH GREY IRON CASTING

TOOLS AND EQUIPMENT: SHAPER, SHAPER VISE, SHAPER TOOL HOLDER, TOOL BIT, PARALLELS, BRASS HAMMER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 37-1 TO 37-16 AND REF. #2, PP. 499-523. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

S-7-1	CHECK MACHINE FOR PROPER RUNNING CONDITION, DRILL DRIFT, S-1-1
S-7-2	SET UP SHAPER, T-NUT, S-2-2
S-7-3	MACHINE WORK PIECE ON SIDES AND EDGES, BENCH PLATE, S-6-3 NOTE: HOLD 10" SQUARE AND 1 1/2" THICKNESS

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK OIL RESERVOIRS.
2. PROPER MACHINE SETUP.
3. ALL DIMENSIONS HELD TO SPECIFICATIONS.
4. ALL SURFACES SQUARE AND PARALLEL TO EACH OTHER.
5. SMOOTH MACHINE FINISH.
6. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

JOB SHEET
IN
MILLING

HM-6

JOB:	MAKE LAPPING PLATE
MATERIALS:	WORK PIECE, IRON PLATE 10" X 10" X 1 1/2" SHAPED TO SIZE
TOOLS AND EQUIPMENT:	MILLING MACHINE, MILLING MACHINE ARBOR AND COLLARS, 1/32" SLITTING SAW, FINGER CLAMPS, DIAL INDICATOR, BRASS HAMMER
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 38-1 TO 38-37 AND REF. #2, PP. 524-564. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.
PROCEDURES AND/OR TASKS:	HM-6-1 CHECK MACHINE FOR PROPER RUNNING CONDITION, T-NUT, HM-1-1 HM-6-2 SET UP MILLING MACHINE, T-NUT, HM-1-2, HM-1-3 NOTE: MOUNT 1/32" SLITTING SAW IN PLACE OF MILL CUTTER; SPEED 60 RPM; FEED .015" PER REVOLUTION HM-6-3 SET UP WORK PIECE HM-6-4 MILL WORK PIECE
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK. 1. PROPER MACHINE SETUP. 2. ALL DIMENSIONS HELD TO SPECIFICATIONS. 3. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: HM-6
TASK: 3
PAGE: 1

TASK: SET UP WORK PIECE
JOB: MAKE LAPPING PLATE
TRADE: MACHINIST
TOOLS AND MATERIALS: MILLING MACHINE, FINGER CLAMPS, WORK PIECE
TASK BREAKDOWN:

STEPS	KEY POINTS
1. CLEAR MILL TABLE	1. REMOVE VISE 2. CLEAN VISE THOROUGHLY WITH RAG 3. STORE VISE IN PROPER PLACE 4. WIPE MILL TABLE CLEAN WITH RAG 5. WIPE MILL TABLE WITH PALM OF HAND
2. LOCATE WORK PIECE	1. WIPE WORK PIECE CLEAN 2. PLACE WORK PIECE FLAT ON TABLE NOTE: CROSS FEED TRAVEL MUST ALLOW CUTTER TO COVER WIDTH OF WORK PIECE
3. CLAMP WORK PIECE	1. PLACE FINGER OF ONE FINGER CLAMP NEAR CENTER OF ONE SIDE OF WORK PIECE 2. LOCATE SECOND FINGER CLAMP ON OPPOSITE SIDE 3. SLIDE "T" BOLT OF PROPER LENGTH INTO TABLE "T" SLOT ON ONE END 4. PLACE END OF BOLT THROUGH THE CLAMP SLOT 5. REPEAT FOR SECOND "T" BOLT AND CLAMP 6. PLACE HEEL 1 1/2" TO 1 3/4" UNDER EACH CLAMP NOTE: THE "T" BOLT SHOULD BE NEAR WORK AND THE HEEL SHOULD BE NEAR OUTER END OF CLAMP. IF HEEL IS CLOSER TO THE BOLT THAN THE WORK PIECE, MOST OF THE HOLDING POWER WILL BE ON THE HEEL INSTEAD

3. CLAMP WORK PIECE (CON'T.)	OF THE WORK PIECE 7. SCREW PROPER NUTS ON "T" BOLTS NOTE: ONLY SNUG NUTS DOWN
4. INDICATE TRUE	1. ATTACH DIAL INDICATOR TO COLUMN OR MACHINE HEAD 2. INDICATE ONE EDGE OF PLATE ZERO NOTE: TAP ONE EDGE OF PLATE WITH BRASS HAMMER TO TRUE WORK 3. TIGHTEN NUTS ON "T" BOLTS TIGHT 4. RECHECK WITH INDICATOR TO BE SURE PART DID NOT MOVE WHILE TIGHTENING NUTS

SKETCHES: DRAWING #12: LAPPING PLATE

REFERENCES: REF. #1, PP. 38-1 TO 38-38
REF. #2, PP. 524-564

TASK SHEET

JOB: HM-6
TASK: 4
PAGE: 1

TASK: MILL WORK PIECE

JOB: MAKE LAPPING PLATE

TRADE: MACHINIST

TOOLS AND MATERIALS: MILLING MACHINE, 1/32" SLITTING SAW, FINGER CLAMPS, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MAKE FINAL ADJUSTMENTS	1. MOVE TABLE TO POSITION BOTTOM OF CUTTER 1/2" BELOW TOP OF WORK PIECE AND OFF INSIDE EDGE 2. PUT SAFETY GOGGLES ON 3. TURN MACHINE ON 4. CHECK DIRECTION OF CUTTER (REF. #1, P. 38-22) 5. HOLD PIECE OF PAPER BETWEEN EDGE OF WORK PIECE AND CUTTER 6. SLOWLY MOVE TABLE IN UNTIL CUTTER CUTS PAPER 7. LOWER TABLE UNTIL BOTTOM OF CUTTER IS ABOVE TOP OF WORK PIECE 8. MOVE TABLE IN EXACTLY .2655" BY THE DIAL NOTE: THIS IS 1/2 WIDTH OF CUTTER PLUS THE 1/4" CALLED FOR ON DRAWING 9. RAISE THE TABLE UNTIL CUTTER JUST TOUCHES WORK PIECE 10. TURN TABLE LONGITUDINAL HANDLE UNTIL WORK PIECE IS CLEAR OF CUTTER NOTE: BE SURE CUTTER IS OFF END TO MAKE A CONVENTIONAL CUT 11. RAISE TABLE .075" BY THE DIAL NOTE: THIS WILL CUT SLOT DEEP ENOUGH FOR SURFACE GRINDING AND STILL HOLD DIMENSIONS 12. LOCK KNEE AND SADDLE

2. CUT SLOTS	1. ENGAGE TABLE LONGITUDINAL FEED LEVER 2. ALLOW CUTTER TO CUT FULL LENGTH OF WORK PIECE NOTE: TABLE SHOULD NOT BE LOWERED 3. RETURN CUTTER TO STARTING POINT 4. LOOSEN SADDLE LOCK 5. MOVE TABLE IN EXACTLY .250" BY THE DIAL 6. ENGAGE FEED CLUTCH AND CUT SECOND SLOT 7. REPEAT SAME PROCEDURE FOR EACH SLOT NOTE: WHEN THE POINT HAS BEEN REACHED WHERE FINGER CLAMPS ARE IN THE WAY, PLACE TWO NEW CLAMPS ON SLOTTED AREA AND REMOVE THE OTHERS. WHEN ENOUGH CUTS HAVE BEEN MADE, REPLACE THE ORIGINAL CLAMPS AND CONTINUE CUTTING UNTIL TASK IS COMPLETED 8. TURN MACHINE OFF AND REMOVE WORK PIECE
3. CUT CROSS LATCH SLOTS	1. ROTATE PLATE 90 DEGREES 2. REPEAT STEPS 1 AND 2
4. REMOVE BURRS	USE THE HONE TO REMOVE BURRS ON GROOVES
5. INSPECT	1. 1 1/2" THICK 2. 10" SQUARE 3. 1/4" BETWEEN CENTER LINE OF SLOTS 4. 1/16" DEEP SLOTS

ROUTE TO SURFACE GRINDER

SKETCHES: DRAWING #12: LAPPING PLATE

REFERENCES: REF. #1, PP. 38-1 TO 38-38
REF. #2, PP. 524-564

JOB SHEET
IN
SURFACE GRINDER

JOB: MAKE LAPPING PLATE

MATERIALS: WORK PIECE, IRON PLATE 10" X 10" X 1 1/2" MILLED TO SPECIFICATIONS

TOOLS AND EQUIPMENT: SURFACE GRINDER, GRINDING WHEEL, MAGNETIC CHUCK, DIAMOND WHEEL DRESSER, SLIP STONE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 33-1 TO 33-14 AND REF. #2, PP. 565-581. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

SG-5-1	CHECK MACHINE FOR PROPER RUNNING CONDITION, PARALLEL BLOCKS, SG-1-1
SG-5-2	SET UP MACHINE FOR GRINDING, PARALLEL BLOCKS, SG-1-1
SG-5-3	GRIND WORK PIECE, PARALLEL BLOCKS, SG-1-3

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. ELECTROMAGNET HOLDING POWER.
2. CORRECT SETUP.
3. GRINDING WHEEL SHARP AND FREE OF CRACKS OR FLAWS.
4. ALL DIMENSIONS HELD TO SPECIFICATIONS.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

MACHINE SHOP ANGLE PLATES

SHAPER	8
MILLING	HM 7/VM 2
SURFACE GRINDER	6

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND CONSTRUCT ANGLE PLATES ACCORDING TO SPECIFICATIONS; USING THE TOOLS, MACHINES, EQUIPMENT, AND MATERIALS CALLED FOR IN THE JOB.

CHECKING STANDARDS

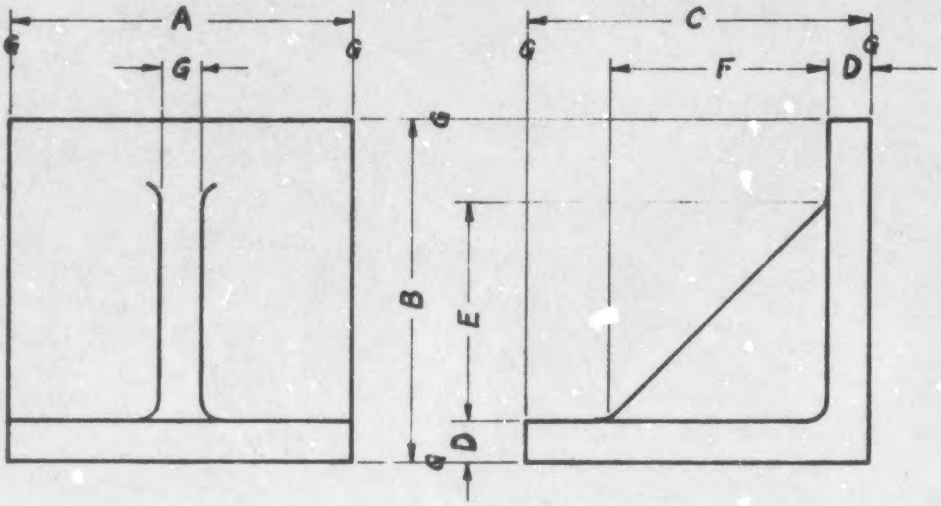
1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.

NOTE: TASK SHEETS FOR THIS JOB ARE DESIGNED FOR REF. #3 ON DRAWING #13. IF OTHER ANGLE PLATES ARE DESIRED, DIMENSIONS MUST BE CHANGED ACCORDINGLY.



ALLOW .020 TO .025 FOR GRINDING

REF. NO.	A	B	C	D	E	F	G
1	2	2	2	7/16			
2	3	3	3	1/2			
3	4	4	4	5/8	2 1/2	2 1/2	1/2
4	4	5	4	3/4	3 1/2	2 1/2	1/2
5	5	6	4	3/4	4 1/2	2 1/2	5/8
6	8	8	6	7/8	5	4	3/4

DRAWING NO. 13	ANGLE PLATE	TOLERANCE CHART
MILLING JOB NO. 7 SHAPER JOB NO. 8 SURFACE GRINDER JOB NO. 6	MATERIAL: CAST IRON FINISH: GRIND SCALE: NONE	FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1/2°

HM-7

JOB SHEET
IN
MILLING

JOB: MAKE ANGLE PLATE

MATERIALS: ONE CAST IRON ANGLE PLATE

TOOLS AND EQUIPMENT: MILLING MACHINE, MILLING MACHINE ARBOR, MILLING MACHINE VISE, 3" HELICAL SLAB MILL, TOOLMAKER'S SQUARE, SCREW JACKS, MILL FILE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 38-1 TO 38-17 AND REF. #2, PP. 524-564. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

HM-7-1	CHECK MACHINE FOR PROPER RUNNING CONDITION, T-NUT, HM-1-1
HM-7-2	SET UP HORIZONTAL MILL, T-NUT, HM-1-2 NOTE: SET SPEED AT 75 RPM AND FEED AT .015" PER REVOLUTION
HM-7-3	MOUNT WORK IN VISE
HM-7-4	MILL FIRST SURFACE ROUTE TO VERTICAL MILL
HM-7-5	MILL SECOND SURFACE. REPEAT TASK 4 NOTE: PLACE PARALLEL BAR UNDER MACHINED EDGE NOTE: CLEAN MACHINE AND WORK AREA AND ROUTE THE WORK PIECE TO VERTICAL MILL

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. OIL RESERVOIRS FILLED TO PROPER LEVEL.
2. PROPER MACHINE SETUP.
3. SMOOTH MACHINE FINISH.
4. ANGULARITY HELD TO SPECIFICATIONS.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: HM-7
TASK: 3
PAGE: 1

TASK:	MOUNT WORK PIECE IN VISE
JOB:	MAKE ANGLE PLATE
TRADE:	MACHINIST
TOOLS AND MATERIALS:	HORIZONTAL MILLING MACHINE, WORK PIECE, MILLING MACHINE VISE, SCREW JACKS

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CLEAN TABLE	1. WIPE TABLE WITH RAG 2. WIPE TABLE WITH HAND
2. SET UP VISE	1. CLEAN BOTTOM OF VISE WITH HAND 2. PLACE VISE ON TABLE WITH JAWS PARALLEL TO ARBOR 3. TIGHTEN WITH WRENCH NOTE: IT WILL NOT BE NECESSARY TO INDICATE VISE TRUE
3. SET UP WORK PIECE	1. OPEN VISE 1/2" 2. PLACE ANGLE PLATE IN VISE WITH ONE FLAT SURFACE UP AND OPEN END TO THE RIGHT NOTE: ANGLE PLATE SUPPORT WILL ONLY ALLOW CLAMPING ON ABOUT 1 1/2" 3. TIGHTEN VISE 4. SET THE SCREW JACKS UNDER UNSUPPORTED END OF ANGLE PLATE NOTE: ONLY SNUG SCREW JACKS TO BE USED

SKETCHES: DRAWING #13: ANGLE PLATE

REFERENCES: REF. #1, PP. 38-18 TO 38-19
REF. #2, PP. 535-536

TASK SHEET

JOB: HM-7
TASK: 4
PAGE: 1

TASK: MILL SURFACE OF WORK PIECE

JOB: MAKE ANGLE PLATE

TRADE: MACHINIST

TOOLS AND MATERIALS: HORIZONTAL MILLING MACHINE, MILLING MACHINE VISE, SCREW JACKS, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MAKE FINAL ADJUSTMENTS	1. MOVE TABLE TO POSITION HELICAL CUTTER OVER AND CLOSE TO WORK 2. PUT SAFETY GOGGLES ON 3. TURN MACHINE ON 4. HOLD A PIECE OF PAPER BETWEEN CUTTER AND WORK PIECE 5. RAISE TABLE SLOWLY UNTIL CUTTER CUTS PAPER 6. MOVE TABLE TO THE RIGHT UNTIL CUTTER IS OFF WORK PIECE 7. RAISE TABLE 1/8" NOTE: WHEN MAKING FIRST CUT ON CAST IRON TAKE LARGE ENOUGH CUT TO GET UNDER HARD SCALE TO PREVENT DULLING CUTTER 8. LOCK KNEE AND SADDLE CLAMPS
2. MAKE ROUGH CUT	1. ENGAGE LONGITUDINAL TABLE FEED 2. ALLOW MACHINE TO COMPLETE CUT 3. TURN SPINDLE OFF
3. REMOVE VISE	1. LEAVE WORK PIECE IN VISE 2. LOOSEN VISE BOLTS 3. REMOVE VISE AND WORK PIECE
4. ROUTE TO VERTICAL MILL	TAKE WORK PIECE IN VISE TO VERTICAL MILL

SKETCHES: DRAWING #13: ANGLE PLATE

REFERENCES: REF. #1, PP. 38-1 TO 38-38
REF. #2, PP. 524-564

VM-2

JOB SHEET
IN
MILLING

JOB:	MAKE AN ANGLE PLATE	
MATERIALS:	ONE CAST IRON ANGLE PLATE	
TOOLS AND EQUIPMENT:	VERTICAL MILLING MACHINE, MILLING MACHINE VISE, 1" END MILL, DIAL INDICATOR, MILL FILE	
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 38-29 TO 38-35 AND REF. #2, PP. 555-558. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.	
PROCEDURES AND/OR TASKS:	VM-2-1	CHECK MACHINE FOR PROPER RUNNING CONDITION, STEP BLOCK, VM-1-1
	VM-2-2	SET UP THE MACHINE FOR MILLING, STEP BLOCK, VM-2-3 NOTE: SET SPEED AT 60 RPM AND FEED AT .005" PER REVOLUTION
	VM-2-3	SET UP WORK FOR MILLING
	VM-2-4	MILL ONE EDGE OF WORK PIECE ROUTE TO HORIZONTAL MILL
	VM-2-5	MILL SECOND EDGE OF WORK PIECE. REPEAT TASK 4 ROUTE TO SURFACE GRINDER NOTE: CLEAN MACHINE AND WORK AREA AND ROUTE WORK PIECE TO SURFACE GRINDER

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. OIL RESERVOIRS FILLED TO PROPER LEVEL.
2. PROPER MACHINE SETUP.
3. SMOOTH MACHINE FINISH.
4. DIMENSIONS A, B, AND C HELD TO DRAWING SPECIFICATIONS.
   NOTE: THE CLOSE DIMENSIONS ARE NOT NECESSARY WHERE ONE OR BOTH SIDES ARE CASTING SURFACES.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: VM-2
TASK: [illegible]
PAGE: 1

TASK: SET UP WORK FOR MILLING

JOB: MAKE ANGLE PLATE

TRADE: MACHINIST

TOOLS AND MATERIALS: VERTICAL MILLING MACHINE, MILLING MACHINE VISE, DIAL INDICATOR, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CLEAN TABLE	1. WIPE TABLE WITH RAG 2. WIPE TABLE WITH HAND
2. SET UP VISE	1. WIPE BOTTOM OF VISE WITH HAND 2. MOUNT VISE WITH JAWS PARALLEL TO TABLE 3. BOLT VISE TO TABLE TIGHT ENOUGH TO HOLD IN PLACE
3. INDICATE WORK	1. MOUNT DIAL INDICATOR ON COLUMN OR VERTICAL HEAD 2. INDICATE TRUE THE FACE OF ANGLE PLATE NOTE: THERE IS ABOUT 2 1/2" ABOVE TOP OF VISE TO INDICATE ON 3. TIGHTEN VISE ON TABLE 4. RECHECK WORK WITH INDICATOR

SKETCHES: DRAWING #13: ANGLE PLATE

REFERENCES: REF. #1, P. 38-22

TASK SHEET

JOB: VM-2
TASK: 5
PAGE: 1

TASK: MILL ONE EDGE OF WORK PIECE

JOB: MAKE ANGLE PLATE

TRADE: MACHINIST

TOOLS AND MATERIALS: VERTICAL MILLING MACHINE, MILLING MACHINE VISE, 1" END MILL, MILL FILE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MAKE FINAL ADJUSTMENTS	1. MOVE TABLE TO POSITION CUTTER JUST OFF EDGE OF WORK PIECE NOTE: THE TOP OF CUTTER FLUTES SHOULD BE ABOVE WORK AND BOTTOM OF FLUTES BELOW WORK 2. PUT SAFETY GOGGLES ON 3. TURN MACHINE SPINDLE ON 4. HOLD A PIECE OF PAPER BETWEEN CUTTER AND WORK PIECE 5. MOVE CUTTER IN SLOWLY UNTIL CUTTER CUTS PAPER 6. MOVE TABLE LONGITUDINALLY TO THE LEFT UNTIL CUTTER IS CLEAR OF WORK PIECE 7. USE DIAL TO MOVE TABLE IN 1/8"
2. MILL FIRST EDGE	1. ENGAGE LONGITUDINAL FEED 2. ALLOW MACHINE TO COMPLETE CUT 3. TURN SPINDLE OFF
3. REMOVE SET UP	1. REMOVE WORK FROM VISE 2. REMOVE VISE FROM MACHINE
4. REMOVE BURRS	1. FILE BURRS LIGHTLY 2. WIPE CLEAN
5. ROUTE WORK TO HORIZONTAL MILL	TAKE VISE AND WORK TO HORIZONTAL MILL

SKETCHES: DRAWING #13: ANGLE PLATE

REFERENCES: REF. #1, PP. 38-29 TO 38-32
REF. #2, PP. 555-558

OPTIONAL S-8

JOB SHEET
IN
SHAPER

JOB: MAKE ANGLE PLATE

MATERIALS: ONE CAST IRON ANGLE PLATE

TOOLS AND EQUIPMENT: SHAPER, SHAPER VISE, PARALLELS, TOOL BIT, BRASS HAMMER, SHAPER TOOL HOLDER, TOOLMAKER'S SQUARE, MILL FILE, SCREW JACKS

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 37-1 TO 37-16 AND REF. #2, PP. 499-523. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

S-8-1 CHECK MACHINE FOR PROPER RUNNING CONDITION, DRILL DRIFT, S-1-1
S-8-2 SET UP SHAPER, DRILL DRIFT, S-1-2
S-8-3 ROUGH AND FINISH SURFACE ON FIRST FACE, STEP BLOCK, S-3-3
S-8-4 MACHINE FIRST EDGE IN SAME SETTING
S-8-5 MACHINE SECOND FACE AND EDGE. REPEAT STEPS 3 AND 4

NOTE: CLEAN MACHINE AND ROUTE WORK PIECE TO SURFACE GRINDER

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. OIL RESERVOIRS FILLED TO PROPER LEVEL.
2. PROPER MACHINE SETUP.
3. SMOOTH MACHINE FINISH.
4. ANGULARITY HELD TO SPECIFICATIONS.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: S-8
TASK: 4
PAGE: 1

TASK: MACHINE FIRST EDGE

JOB: MAKE ANGLE PLATE

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, SHAPER TOOL HOLDER, TOOL BIT, PARALLELS, SCREW JACKS, MILL FILE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP CLAPPER BOX	1. LOOSEN APRON CLAMP BOLTS 2. SWIVEL THE CLAPPER BOX 20 DEGREES AWAY FROM EDGE 3. TIGHTEN APRON CLAMP BOLTS
2. POSITION TOOL	1. POSITION CUTTING TOOL AT END OF WORK 2. SET TOOL HEAD TO REMOVE 1/3" MATERIAL 3. SET FEED AT .020" PER CUT
3. MAKE ROUGH CUT	1. PUT SAFETY GOGGLES ON 2. TURN MOTOR ON 3. ENGAGE RAM CLUTCH 4. ALLOW MACHINE TO COMPLETE CUT 5. DISENGAGE RAM CLUTCH 6. HAND CRANK TABLE BACK TO STARTING POSITION
4. MAKE FINISH CUT	1. SET FEED AT .010" PER CUT 2. ALLOW .020" FOR GRINDING 3. SET TOOL HEAD 4. REPEAT STEP 3 5. STOP MACHINE 6. REMOVE WORK PIECE
5. REMOVE BURRS	1. FILE LIGHTLY 2. WIPE CLEAN

SKETCHES: DRAWING #13: ANGLE PLATE

REFERENCES: REF. #1, PP. 37-1 TO 37-16
REF. #2, PP. 499-523

SG-6

JOB SHEET
IN
SURFACE GRINDER

JOB:	MAKE ANGLE PLATE
MATERIALS:	WORK PIECE, CAST IRON ANGLE PLATE MACHINED AND READY FOR GRINDING
TOOLS AND EQUIPMENT:	SURFACE GRINDER, GRINDING WHEEL, MAGNETIC CHUCK, ANGLE PLATE, DIAMOND DRESSER, MACHINIST'S CLAMPS, SCREW JACKS, MILL FILE, TOOLMAKER'S SQUARE
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 33-1 TO 33-14 AND REF. #2, PP. 565-581. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:	SG-6-1	CHECK MACHINE FOR PROPER RUNNING CONDITION, PARALLEL BLOCKS, SG-1-1
	SG-6-2	SET UP MACHINE FOR GRINDING, PARALLEL BLOCKS, SG-1-1 NOTE: USE WHEEL CORRESPONDING TO NORTON 3730-JS
	SG-6-3	SET UP WORK PIECE FOR GRINDING
	SG-6-4	GRIND WORK PIECE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. ELECTROMAGNETIC HOLDING POWER.
2. CORRECT SETUP.
3. GRINDING WHEEL SHARP AND FREE OF CRACKS OR FLAWS.
4. DIMENSIONS A, B, AND C HELD TO DRAWING SPECIFICATIONS.
5. ANGULARITY HELD TO SPECIFICATIONS.
6. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: SG-6
TASK: 3
PAGE: 1

TASK: SET UP WORK PIECE FOR GRINDING

JOB: MAKE ANGLE PLATE

TRADE: MACHINIST

TOOLS AND MATERIALS: SURFACE GRINDER, MAGNETIC CHUCK, ANGLE PLATE, MACHINISTS' CLAMPS, SCREW JACKS, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT ANGLE PLATE ON CHUCK	1. SELECT A 4" FINISHED ANGLE PLATE 2. WIPE THE ANGLE PLATE CLEAN WITH HANDS 3. CHECK FOR BURRS AND FILE IF NECESSARY NOTE: LAY FILE FLAT ON SURFACE AND FILE SMOOTH 4. PLACE ANGLE PLATE ON MAGNETIC CHUCK WITH FACE PARALLEL TO THE TABLE 5. TURN THE ELECTROMAGNETIC CHUCK POWER ON
2. MOUNT WORK PIECE	1. PLACE FACE OF WORK PIECE AGAINST THE FINISHED ANGLE PLATE WITH MACHINED EDGE ON CHUCK 2. CLAMP WORK PIECE TO FINISHED ANGLE PLATE WITH MACHINISTS' CLAMPS 3. SUPPORT OVERHANG WITH THE SCREW JACKS

SKETCHES: DRAWING #13: ANGLE PLATE

REFERENCES: REF. #2, P. 210, FIG. 428

TASK SHEET

JOB: SG-6
TASK: 4
PAGE: 1

TASK: GRIND WORK PIECE

JOB: MAKE ANGLE PLATE

TRADE: MACHINIST

TOOLS AND MATERIALS: SURFACE GRINDER, GRINDING WHEEL, MAGNETIC CHUCK, PARALLEL, ANGLE PLATE, MACHINISTS' CLAMPS, WORK PIECE, TOOLMAKER'S SQUARE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MAKE FINAL ADJUSTMENTS	1. POSITION GRINDING WHEEL 1/8" ABOVE SURFACE TO BE GROUND
	2. SET TRAVEL STOPS TO 1/2" OFF WORK PIECE ON EACH END
	3. SET MACHINE TO FEED 1/2 OF WHEEL OFF EACH SIDE OF WORK PIECE
2. GRIND FIRST FACE	1. PUT SAFETY GOGGLES ON
	2. TURN SPINDLE ON
	3. TURN MOTOR ON
	4. LOWER GRINDING WHEEL SLOWLY UNTIL WHEEL TOUCHES WORK
	5. GRIND ENTIRE SURFACE
	6. REMOVE .002" PER CUT UNTIL TOTAL OF .010" HAS BEEN REMOVED
	7. TURN SPINDLE OFF
	8. REMOVE WORK PIECE
3. REMOVE BURRS	FILE LIGHTLY
4. GRIND SECOND FACE	1. REPEAT STEPS 1 AND 2
	2. REMOVE .010" STOCK
	3. REPEAT STEP 3
	4. REMOVE FINISHED ANGLE PLATE
5. INSPECT	1. CHECK ANGULARITY
	2. REGRIND IF NECESSARY NOTE: USE SCREW JACKS TO CHANGE ANGULARITY
6. SET UP FOR EDGE	1. CLEAN CHUCK WITH HAND
	2. CLEAN WORK PIECE WITH HAND

6.	SET UP FOR EDGE (CON'T.)	3. PLACE ONE FACE ON CHUCK WITH EDGE PARALLEL TO TABLE 4. TURN ELECTROMAGNETIC ON 5. REPEAT STEP 1
7.	GRIND EDGE	GRIND EDGE TO HOLD DIMENSION "A" TO 4"
8.	REMOVE BURRS	REPEAT STEP 3
9.	GRIND SECOND EDGE	REPEAT STEPS 6-8
10.	SET UP TO GRIND SIDES	1. REPEAT TASK 3 2. LAY A PARALLEL BAR FLAT AGAINST THE FINISHED ANGLE PLATE NOTE: THIS WILL ALLOW THE WORK PIECE TO BE OFF THE CHUCK 3. PLACE FACE OF WORK PIECE AGAINST FACE OF ANGLE PLATE 4. SET ONE UNCUT SURFACE ON PARALLEL BAR 5. CLAMP WORK PIECE TO ANGLE PLATE WITH MACHINISTS' CLAMPS
11.	GRIND FIRST SIDE	1. REPEAT STEPS 2 AND 3 2. GRIND TO MINIMUM CLEAN UP 3. TURN MACHINE OFF 4. TURN ELECTROMAGNETIC OFF 5. REMOVE WORK PIECE 6. REMOVE, CLEAN, AND PUT UP PARALLEL BAR 7. REMOVE THE FINISHED ANGLE PLATE, CLEAN AND STORE 8. CLEAN CHUCK WITH HAND
12.	GRIND SECOND SIDE	1. MOUNT WORK PIECE GROUND SIDE ON CHUCK 2. REPEAT STEP 2 AND 3 NOTE: HOLD DIMENSION "B" TO 4"
13.	INSPECT	1. DIMENSION "A" - 4" ± .010" 2. DIMENSION "B" - 4" ± .010" 3. DIMENSION "C" - 4" ± .010" 4. ANGULARITY ± .002" AT 12" NOTE: CLOSE DIMENSIONS ARE NOT REQUIRED TO BE HELD WHERE CASTING SURFACE CONSTITUTES ONE OR MORE SIDES

SKETCHES: DRAWING #13: ANGLE PLATE

REFERENCES: REF. #1, PP. 33-1 TO 33-14
REF. #2, PP. 565-581

MACHINE SHOP MANDREL

POWER HACKSAW	6
ENGINE LATHE	3
SHAPER	9
MILLING	8/VM-3
CYLINDRICAL GRINDER	2
HEAT TREAT	5

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND CONSTRUCT A LATHE MANDREL ACCORDING TO SPECIFICATIONS; USING TOOLS, EQUIPMENT, MACHINES, AND MATERIALS CALLED FOR IN THE JOB.

CHECKING STANDARDS

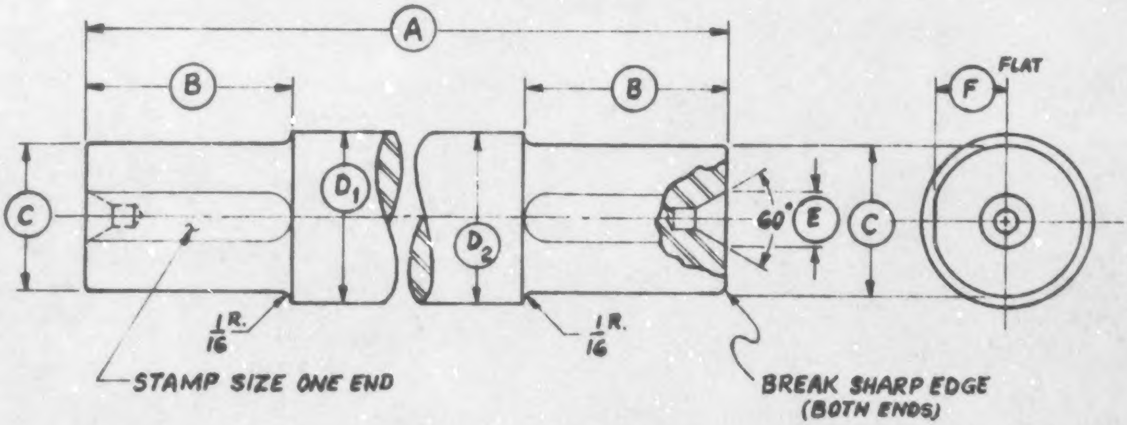
1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.

NOTE: THE TASK SHEETS FOR THIS JOB ARE FOR A 1/2" MANDREL. IF OTHER SIZES ARE DESIRED, DIMENSIONS MUST BE CHANGED ACCORDINGLY.


A
B
B
F
FLAT
C
D1
D2
60°
E
C
1/16 R.
1/16 R.
STAMP SIZE ONE END
BREAK SHARP EDGE
(BOTH ENDS)

NOTE: D_1 = TURNED DIAMETER – TOLERANCE ±.002
D_2 = GROUND DIAMETER – TOLERANCE ±.0001

SIZE	A	B	C	D_1	D_2	E	F
1/4	3 3/4	5/8	7/32	.254	.248	3/32	3/32
5/16	4	11/16	17/64	.316	.310	7/64	7/64
3/8	4 1/4	3/4	21/64	.379	.373	5/32	9/64
7/16	4 1/2	13/16	3/8	.441	.435	11/64	11/64
1/2	5	7/8	7/16	.504	.498	11/64	3/16
5/8	5 1/2	1	35/64	.629	.623	3/16	1/4
3/4	6	1 1/16	21/32	.754	.748	13/64	19/64
7/8	6 1/2	1 1/8	25/32	.879	.873	7/32	23/64
1	7	1 3/16	7/8	1.004	.998	1/4	13/32
1 1/8	7 1/2	1 3/16	1	1.129	1.123	9/32	15/32
1 1/4	8	1 3/16	1 1/8	1.254	1.248	5/16	17/32
1 1/2	9	1 7/16	1 3/8	1.504	1.498	3/8	21/32

DRAWING NO. 15	MANDRELS	TOLERANCE CHART
LATHE JOB NO. MILLING JOB NO. 8 OR SHAPER JOB NO. 9 CYL. GRINDER JOB NO. 2	MATERIAL: MILD STEEL FINISH: GRIND SCALE: NONE	FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1/4°

PH-6

JOB SHEET
IN
POWER HACKSAW

JOB:	MAKE LATHE MANDREL	
MATERIALS:	ONE BAR OF ROUND 5 1/8" X 5/8" MILD STEEL STOCK	
TOOLS AND EQUIPMENT:	POWER HACKSAW, 6" RULE, MILL FILE	
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 35-1 TO 35-1. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.	
PROCEDURES AND/OR TASKS:	PH-6-1	CHECK POWER HACKSAW FOR PROPER RUNNING CONDITION, CLAMP STRAP, PH-1-1
	PH-6-2	SAW STOCK TO LENGTH, CLAMP STRAP, PH-1-2
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK. 1. CUT AT 5 1/8" LENGTH. 2. CORRECT SETUP. 3. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.	

JOB SHEET
IN
ENGINE LATHE

EL-3

JOB:	MAKE LATHE MANDREL	
MATERIALS:	WORK PIECE 5/8" ROUND 5 1/8" LONG MILD STEEL BAR	
TOOLS AND EQUIPMENT:	ENGINE LATHE, UNIVERSAL CHUCK, JACOBS CHUCK, CENTER DRILL, FACING TOOL, DRIVE PLATE, LIVE AND DEAD CENTERS, TURNING TOOLS, LATHE DOG, MICROMETERS, HERMAPHRODITE CALIPERS	
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 36-1 TO 36-44 AND REF. #2, PP. 462-493. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.	
PROCEDURES AND/OR TASKS:	EL-3-1	CHECK MACHINE FOR PROPER RUNNING CONDITION, STUD, EL-1-1
	EL-3-2	MOUNT WORK IN UNIVERSAL CHUCK, STUD, EL-1-2b
	EL-3-3	FACE AND CENTER DRILL EACH END, TEST BAR, EL-2-2, EL-2-3 NOTE: HOLD TO 5" LENGTH
	EL-3-4	LAYOUT WITH HERMAPHRODITE CALIPER
	EL-3-5	TURN SMALL DIAMETER ON EACH END, TEST BAR, EL-2-6, EL-2-7 NOTE: SET SPEED 400 RPM, FEED .006" PER REVOLUTION AND HOLD 7/16" DIAMETER AND 7/8" LENGTH
	EL-3-6	TURN LARGE DIAMETER, TEST BAR, EL-2-7 NOTE: HOLD .504" DIAMETER AND 3 1/4" LENGTH
	EL-3-7	FILE 1/64" RADII ON ENDS
	EL-3-8	STENCIL WORK PIECE, LIMIT GAUGE, B-9b NOTE: STAMP 1/2 ON THE LARGE END AS SHOWN IN DRAWING

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. OIL RESERVOIRS FILLED TO PROPER LEVEL.
2. PROPER MACHINE SETUP.
3. ACCURACY OF CENTERS.
4. ALL DIMENSIONS HELD TO SPECIFICATIONS.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: EL-3
TASK: 4
PAGE: 1

TASK: LAYOUT WITH HERMAPHRODITE CALIPER

JOB: MAKE LATHE MANDREL

TRADE: MACHINIST

TOOLS AND MATERIALS: HERMAPHRODITE CALIPER, 6" STEEL RULE, LAYOUT FLUID, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET CALIPER	1. LAY RULE FLAT ON TABLE 2. PICK UP HERMAPHRODITE CALIPER 3. PLACE HOOL END OF CALIPER AGAINST END OF RULE 4. TURN CALIPER ADJUSTING SCREW UNTIL POINT OF CALIPER IS ON 7/8"
2. INK WORK PIECE	1. PUT LAYOUT INK ON BOTH ENDS OF WORK PIECE ABOUT 7/8" FROM END 2. ALLOW INK TO DRY
3. MAKE LAYOUT	1. PLACE HOOK END OF CALIPER AGAINST END OF WORK PIECE 2. SCRIBE LINE AROUND WORK WITH THE POINT 3. REPEAT ON OPPOSITE END

ROUTE TO LATHE

SKETCHES: DRAWING #15: LATHE MANDREL

REFERENCES: REF. #1, P. 5-1
REF. #2, PP. 52-54

JOB SHEET
IN
SHAPER

JOB: MAKE LATHE MANDREL

MATERIALS: ONE LATHE MANDREL CENTERED AND TURNED READY FOR CUTTING FLATS

TOOLS AND EQUIPMENT: SHAPER, SHAPER VISE, PARALLELS, SHAPER TOOL HOLDER, TOOL BIT, BRASS HAMMER, MILL FILE, MICROMETER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 37-1 TO 37-16 AND REF. #2, PP. 499-523. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

S-9-1 CHECK MACHINE FOR PROPER RUNNING CONDITION, DRILL DRIFT, S-1-1
S-9-2 SET UP TO MACHINE FLATS
S-9-3 MACHINE FLATS

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. MACHINE VISE INDICATED TRUE.
2. FLATS HELD TO SPECIFICATIONS.
3. SMOOTH MACHINE FINISH.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: S-9
TASK: 2
PAGE: 1

TASK: SET UP TO MACHINE FLATS

JOB: MAKE LATHE MANDREL

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, SHAPER VISE, SURFACE GAUGE, BRASS HAMMER, PARALLELS, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHECK VISE	1. VISE WELL BELOW RAM
	2. VISE JAWS PERPENDICULAR TO RAM
	3. MOUNT DIAL INDICATOR ON RAM
	4. DISENGAGE RAM
	5. HAND FEED RAM TO INDICATE VISE TRUE
2. SET UP MACHINE	1. MOUNT TOOL HOLDER TO CLAPPER BOX
	2. MOUNT ROUND NOSE TOOL IN TOOL HOLDER
	3. SET LENGTH OF STROKE 1/2" BEFORE TOOL STARTS CUT AND 3/4"-1" PAST CUT
	4. SET FEED TO REMOVE .003" PER CUT
	5. SET SPEED OF STROKE
3. MOUNT WORK	1. OPEN VISE
	2. PLACE PROPER PARALLELS IN VISE TO RAISE WORK PIECE ENOUGH ABOVE VISE JAWS FOR CUT
	3. PLACE WORK PIECE IN VISE WITH THE STENCIL MARK DOWN
	4. TAP WORK PIECE INTO POSITION WITH HAMMER
	5. TIGHTEN VISE

SKETCHES: DRAWING #15: LATHE MANDREL

REFERENCES: REF. #1, PP. 6-3 TO 6-1
REF. #2, PP. 57-58

TASK SHEET

JOB: S-9
TASK: 3
PAGE: 1

TASK: MACHINE FLATS

JOB: MAKE LATHE MANDREL

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, SHAPER VISE, MILL FILE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION TOOL	1. HAND FEED RAM TO POSITION CUTTING TOOL OVER WORK 2. RAISE TABLE UNTIL WORK IS 1/16" BELOW CUTTING TOOL 3. TOOL HEAD SHOULD BE NEAR CENTER OF MOVEMENT
2. CUT FIRST FLAT	1. PUT SAFETY GOGGLES ON 2. START MACHINE 3. HAND FEED WORK SLOWLY UNTIL TOOL BEGINS TO CUT 4. START AUTOMATIC FEED 5. CUT TO SHOULDER 6. HOLD FLAT TO 3/16" DIMENSION 7. STOP MACHINE
3. CUT SECOND FLAT	1. REPEAT STEPS 1 AND 2 ON OPPOSITE END OF WORK PIECE 2. REMOVE WORK PIECE
4. REMOVE BURRS	FILE LIGHTLY
5. CLEAN MACHINE	1. REMOVE TOOL AND STORE 2. REMOVE, WIPE, AND STORE PARALLELS 3. BRUSH CHIPS FROM MACHINE AND VISE 4. WIPE CLEAN WITH RAG

ROUTE TO HEAT TREAT

SKETCHES: DRAWING #15: LATHE MANDREL

REFERENCES: REF. #1, PP. 37-1 TO 37-16
REF. #2, PP. 499-523

OPTIONAL VM-3

JOB SHEET
IN
MILLING

JOB: MAKE LATHE MANDREL

MATERIALS: LATHE MANDREL CENTERED AND TURNED READY FOR MILLING FLATS

TOOLS AND EQUIPMENT: MILLING MACHINE, MILLING MACHINE VISE, PARALLELS, 1" END MILL, COLLET CHUCK OR ADAPTER, BRASS HAMMER, MICROMETER, MILL FILE

GENERAL INSTRUCTIONS:

VM-3-1	CHECK MACHINE FOR PROPER RUNNING CONDITION, T-NUT, HM-1-1
VM-3-2	MOUNT WORK IN VISE, STEP BLOCK, VM-1-2 NOTE: STENCIL WORK DOWN
VM-3-3	SET UP MACHINE, STEP BLOCK, VM-1-3 NOTE: USE 1" END MILL
VM-3-4	MILL FLATS

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. OIL RESERVOIRS FILLED TO PROPER LEVEL.
2. PROPER MACHINE SETUP.
3. MACHINE VISE INDICATED TRUE.
4. END MILL SHARP.
5. DIMENSION "F" HELD.
6. SMOOTH MACHINE FINISH.
7. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: VM-3
TASK: 4
PAGE: 1

TASK: MILL FLATS

JOB: MAKE LATHE MANDREL

TRADE: MACHINIST

TOOLS AND MATERIALS: VERTICAL MILLING MACHINE, VERTICAL MILLING MACHINE VISE, 1" END MILL, MICROMETER, MILL FILE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION CUTTER	1. TURN TABLE CROSS SLIDE AND ELEVATION HANDWHEEL TO POSITION CUTTER 1/16" OVER EITHER END OF WORK PIECE
	2. LINE UP INSIDE EDGE OF CUTTER WITH LAYOUT LINE
	3. LOCK TABLE LONGITUDINAL LOCK
2. CUT FIRST END	1. PUT SAFETY GOGGLES ON
	2. START MACHINE
	3. RAISE TABLE UNTIL CUTTER TOUCHES WORK PIECE
	4. MOVE CROSS SLIDE OUT UNTIL WORK IS AWAY FROM CUTTER
	5. RAISE TABLE .030" AND HAND FEED TABLE IN UNTIL CUTTER CUTS ACROSS ENTIRE PART
	6. CHECK DIMENSION "F" AND TAKE NECESSARY CUT
	7. STOP MACHINE
3. CUT OPPOSITE END	1. REPEAT STEPS 1 AND 2
	2. REMOVE WORK PIECE
4. REMOVE BURRS	FILE LIGHTLY
5. CLEAN MACHINE	1. REMOVE TOOL AND CHUCK, CLEAN AND STORE
	2. WIPE AND STORE PARALLELS
	3. BRUSH AND WIPE MACHINE AND VISE
	4. DISPOSE OF WASTE
ROUTE TO HEAT TREAT	SAME AS PARALLEL BLOCKS, HT-1

SKETCHES: DRAWING #15: LATHE MANDREL

REFERENCES: REF. #1, PP. 38-29 TO 38-32
REF. #2, PP. 555-558

290

CG-2

JOB SHEET
IN
CYLINDRICAL GRINDER

JOB: MAKE LATHE MANDREL

MATERIALS: HARDENED STEEL MANDREL WITH FLATS MILLED OR SHAPED READY FOR GRINDING

TOOLS AND EQUIPMENT: CYLINDRICAL GRINDER, GRINDER DOG, DIAMOND DRESSER, CENTER LAP, 1" MICROMETER, HONE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 33-1 TO 33-15 AND REF. #2, PP. 566-567. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

CG-2-1 CHECK MACHINE FOR PROPER RUNNING CONDITION, TEST BAR, CT-1-1

CG-2-2 SET UP MACHINE FOR GRINDING, TEST BAR, CG-1-2

NOTE: LATHE DOG SHOULD BE MOUNTED ON STENCILED END OF WORK PIECE. PROTECT WORK FROM LATHE DOG SET SCREW

CG-2-3 GRIND WORK PIECE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. OIL RESERVOIRS.
2. COOLANT RESERVOIR.
3. COOLANT FLOW.
4. WHEEL FLAWS.
5. TABLE FEED REVERSING DOGS.
6. GUARDS.
7. SET UP.
8. DIMENSIONS HELD TO SPECIFICATIONS.
9. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: CG-2
TASK: 3
PAGE: 1

TASK: GRIND WORK PIECE

JOB: MAKE LATHE MANDREL

TRADE: MACHINIST

TOOLS AND MATERIALS: CYLINDRICAL GRINDER, GRINDER DOG, 1" MICROMETER, HONE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. ADJUST TAILSTOCK	1. LOOSEN TAILSTOCK TAPER DOCKING BOLTS
	2. INSERT PROPER WRENCH TO MOVE TAILSTOCK IN
	3. MOVE TAILSTOCK IN .010" NOTE: THERE IS NO WAY OF KNOWING IF THE TAILSTOCK HAS BEEN MOVED THE PROPER AMOUNT. IT MAY BE NECESSARY TO MOVE AND GRIND AGAIN
	4. TIGHTEN LOCKING BOLTS
2. GRIND TAPER TO CLEAN-UP	1. PUT SAFETY GOGGLES ON
	2. START WORK ROTATION
	3. START SPINDLE
	4. START COOLANT PUMP
	5. ENGAGE TABLE TRAVEL
	6. SLOWLY BRING THE WHEEL INTO WORK PIECE DIMENSION "B"
	7. GRIND TO CLEAN-UP
	8. STOP MACHINE
3. INSPECT	1. USE 1" MICROMETER
	2. CHECK BOTH ENDS OF DIMENSION "B" NOTE: THERE SHOULD BE .006" TAPER IN WORK PIECE WITH RIGHT END BEING THE SMALLEST. IF NECESSARY, RESET AND GRIND AGAIN
	3. GRIND TAPER TO FINISH SIZE ACCORDING TO DRAWING
4. REMOVE BURRS	USE HONE TO REMOVE BURRS

5. CLEAN UP MACHINE	1. BRUSH AND WIPE MACHINE 2. CLEAN AND STORE END MILL

SKETCHES: DRAWING #15: LATHE MANDREL

REFERENCES: REF. #1, P. 33-5
REF. #2, PP. 566-567

MACHINE SHOP ARBOR COLLAR

POWER HACKSAW	7
ENGINE LATHE	4
TURRET LATHE	2
SHAPER	10
HEAT TREAT	6
INTERNAL GRINDER	1
SURFACE GRINDER	7
CYLINDRICAL GRINDER	3

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWINGS, AND CONSTRUCT AN ARBOR COLLAR ACCORDING TO SPECIFICATIONS; USING TOOLS, MACHINES, EQUIPMENT, AND MATERIALS CALLED FOR IN THE JOB.

CHECKING STANDARDS

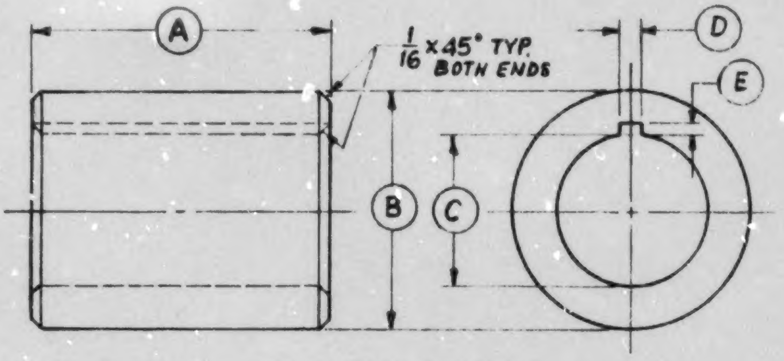
1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.

REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS.



CARB. HDN. & GRIND

ARBOR SIZE	REF. NO.	"A" LENGTH		"B" OUTSIDE DIA.		"C" BORE		D	E
		TURN ±.005	GRIND ±.0002	TURN ±.002	GRIND ±.001	TURN ±.002	GRIND ±.0002		
$\frac{7}{8}$"	1	.390	.375	1.387	1.375	.868	.8752	.130	.068
	2	.453	.4375						
	3	.515	.500						
	4	.640	.625						
	5	.765	.750						
	6	.890	.875						
	7	1.015	1.000						
	8	1.265	1.250						
1"	1	.390	.375	1.512	1.500	.994	1.0002	.260	.098
	2	.453	.4375						
	3	.515	.500						
	4	.640	.625						
	5	.765	.750						
	6	.890	.875						
	7	1.015	1.000						
	8	1.265	1.265						
$1\frac{1}{4}$"	1	.390	.375	1.762	1.750	1.244	1.2502	.320	.130
	2	.453	.4375						
	3	.515	.500						
	4	.640	.625						
	5	.765	.750						
	6	.890	.875						
	7	1.015	1.015						
	8	1.265	1.250						

DRAWING NO. 16	ARBOR COLLAR	TOLERANCE CHART
LATHE JOB NO. 4 - TURRET LATHE JOB NO. 2 - SURFACE GRINDER JOB NO. 7 - CYL. GRINDER JOB NO 3 - INT. GRINDER JOB NO. 1 - SHAPER JOB 10	MATERIAL: MILD STEEL FINISH: GRIND SCALE: NONE	FRACTIONS ± 1/64 DECIMALS ±.005 ANGLES ± 1/4°

PH-7

JOB SHEET
IN
POWER HACKSAW

JOB:	MAKE ARBOR COLLAR	
MATERIALS:	ONE BAR OF ROUND 7/8" X 15/16" MILD STEEL STOCK	
TOOLS AND EQUIPMENT:	POWER HACKSAW, 6" RULE, MILL FILE	
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 35-1 TO 35-1. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.	
PROCEDURES AND/OR TASKS:	PH-7-1	CHECK POWER HACKSAW FOR PROPER RUNNING CONDITION, CLAMP STRAP, PH-1-1
	PH-7-2	SAW STOCK TO LENGTH, CLAMP STRAP, PH-1-2
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK. 1. CUT AT 7/8" LENGTH. 2. CORRECT SETUP. 3. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.	

JOB SHEET
IN
ENGINE LATHE

JOB: MAKE ARBOR COLLAR

MATERIALS: ONE BAR OF ROUND 15/16" X 7/8" LONG MILD STEEL

TOOLS AND EQUIPMENT: ENGINE LATHE, LATHE TOOL HOLDER, TOOL BIT

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 36-1 TO 36-44 AND REF. #2, PP. 462-493. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

EL-4-1	CHECK MACHINE FOR PROPER RUNNING CONDITION, STUD, EL-1-1
EL-4-2	MOUNT WORK IN UNIVERSAL CHUCK. STUD, EL-1-2b NOTE: ALLOW 1/4" TO PROTRUDE FROM JAWS OF CHUCK
EL-4-3	FACE ENDS, STUD, EL-1-4
EL-4-4	DRILL CENTER HOLE IN END, TEST BAR, EL-2-4
EL-4-5	DRILL 13/16" HOLE
EL-4-6	BORE HOLE TO SIZE
EL-4-7	CHAMFER HOLE
EL-4-8	SETUP TO TURN WORK PIECE ON MANDREL
EL-4-9	TURN WORK PIECE, TEST BAR, EL-2-7 NOTE: ALWAYS FEED TOOL TOWARD THE HEADSTOCK TO AVOID PULLING THE WORK PIECE OFF MANDREL. HOLD 1.387" ± .002"
EL-4-10	FACE AND CHAMFER ENDS

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. OIL RESERVOIRS FILLED TO RUNNING LEVEL.
2. PROPER MACHINE SETUP FOR EACH TASK.
3. ALL DIMENSIONS HELD TO SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: EL-4
TASK: 5
PAGE: 1

TASK: DRILL 13/16" HOLE

JOB: MAKE ARBOR COLLAR

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, 13/16" TAPER SHANK DRILL, OIL CAN, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP DRILL	1. SELECT SHARP 13/16" TAPER SHANK DRILL 2. INSERT DRILL INTO THE TAILSTOCK OF LATHE WITH A QUICK JABBING MOTION 3. USE DRILL SLEEVE IF NECESSARY
2. POSITION DRILL	1. SLIDE TAILSTOCK TOWARD HEADSTOCK UNTIL POINT OF DRILL IS 1/4" FROM WORK PIECE 2. LOCK TAILSTOCK WITH LOCKING LEVER
3. SET MACHINE SPEED	SET RPM AT 200
4. DRILL HOLE	1. PUT SAFETY GOGGLES ON 2. OIL END OF DRILL 3. TURN MACHINE ON 4. FEED DRILL INTO WORK PIECE USING THE TAILSTOCK HANDWHEEL NOTE: WITHDRAW DRILL FROM EVERY 1/4" HOLE AND SQUIRT OIL IN HOLE 5. CONTINUE DRILLING UNTIL HOLE IS THROUGH 6. REMOVE DRILL BY TURNING TAILSTOCK HANDWHEEL COUNTERCLOCKWISE UNTIL DRILL POPS LOOSE

SKETCHES: DRAWING #16: ARBOR COLLAR

REFERENCES: REF. #1, PP. 36-35
REF. #2, P. 485

TASK SHEET

JOB: EL-4
TASK: 6
PAGE: 1

TASK:	BORE HOLE TO SIZE
JOB:	MAKE ARBOR COLLAR
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ENGINE LATHE, OIL CAN, BORING TOOL, BORING BAR, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SELECT BORING BAR	1. USE LARGEST BAR THAT WILL PERMIT BORING
	2. USE SHORTEST BAR POSSIBLE TO OBTAIN LENGTH
	3. USE SHARP TOOL
2. MOUNT BORING BAR	1. PLACE BORING BAR IN HOLDER
	2. PLACE HOLDER IN TOOL POST
	3. MOUNT BORING BAR PARALLEL TO WAYS WITH TOOL TOWARD THE WORK PIECE NOTE: TOOL SHOULD BE ON SIDE OF BAR NEAREST OPERATOR
	4. TIGHTEN TOOL POST
3. SET MACHINE	1. SET FEED TO .003" PER REVOLUTION
	2. SET SPEED AT 300 RPM
4. POSITION TOOL	1. MOVE CARRIAGE HANDWHEEL TO POSITION CUTTING TOOL 1/4" FROM WORK PIECE
	2. USE CROSS SLIDE HANDWHEEL TO CENTER TOOL
5. BORE HOLE	1. PUT SAFETY GOGGLES ON
	2. TURN MACHINE ON FORWARD
	3. MOVE CARRIAGE UNTIL TOOL IS INSIDE HOLE BUT NOT TOUCHING
	4. BRING CROSS SLIDE OUT UNTIL TOOL BEGINS TO TOUCH
	5. TURN CARRIAGE HANDWHEEL CLOCKWISE UNTIL TOOL IS OUT OF THE WORK PIECE

5. BORE HOLE (CON'T.)	6. USE DIAL TO BRING CROSS SLIDE OUT .010" 7. SQUIRT SOME OIL IN HOLE 8. ENGAGE TABLE LONGITUDINAL TRAVEL 9. WHEN TOOL PASSES THROUGH WORK, ENGAGE FEED REVERSE LEVER 10. PERMIT TOOL TO FEED BACK THROUGH HOLE 11. STOP MACHINE 12. CHECK DIAMETER OF HOLE 13. CONTINUE BORING UNTIL HOLE IS .868" ± .002" NOTE: THIS LEAVES SUFFICIENT STOCK FOR GRINDING 14. TURN MACHINE OFF 15. REMOVE, CLEAN, AND STORE BORING BAR

SKETCHES: DRAWING #16: ARBOR COLLAR

REFERENCES: REF. #2, PP. 485-486

TASK SHEET

JOB: EL-4
TASK: 7
PAGE: 1

TASK: CHAMFER HOLE

JOB: MAKE ARBOR COLLAR

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, CUTTING TOOL, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP COMPOUND REST	1. SELECT REGULAR TOOL
	2. MOUNT TOOL IN TOOL HOLDER
	3. SWING TOOL HOLDER IN TOOL POST UNTIL TOOL IS PERPENDICULAR TO WORK. TIGHTEN TOOL HOLDER IN TOOL POST WITH SET SCREW
	4. LOOSEN THE COMPOUND REST LOCKING NUTS
	5. TURN COMPOUND REST TO 45 DEGREES
	6. USE DEGREE INDICATOR ON BASE
	7. TIGHTEN LOCKING NUTS
2. POSITION TOOL	1. MOVE THE CARRIAGE HANDWHEEL AND CROSS SLIDE HANDWHEEL UNTIL TOOL IS 1/4" FROM END OF WORK PIECE
	2. PUT SAFETY GOGGLES ON
	3. TURN MACHINE ON FORWARD
	4. POSITION TOOL ON INSIDE EDGE OF HOLE NEAREST OPERATOR
	5. TOOL SHOULD HAVE 1/2 CUTTING EDGE INSIDE AND 1/2 OUTSIDE WORK PIECE
3. MAKE CHAMFER CUT	1. MOVE CROSS SLIDE OUT UNTIL TOOL CUTS 1/16" CHAMFER IN HOLE
	2. MOVE CARRIAGE TOWARD TAILSTOCK TO GET IT OUT OF THE WAY
	3. TURN MACHINE OFF
	4. REMOVE WORK PIECE

SKETCHES: DRAWING #16: ARBOR COLLAR

REFERENCES: REF. #2. PP. 479-480

TASK SHEET

JOB: EL-4
TASK: 8
PAGE: 1

TASK: SET UP TO TURN WORK PIECE ON MANDREL

JOB: MAKE ARBOR COLLAR

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, MANDREL, BRASS HAMMER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK PIECE ON MANDREL	1. SELECT PROPER MANDREL 2. PLACE WORK PIECE ON MANDREL FININSHED END FIRST 3. TAP WORK PIECE ON MANDREL GENTLY 4. USE BRASS HAMMER
2. INSTALL CENTERS	1. INSTALL FACE PLATE 2. BE SURE FACE PLATE AND SPINDLE THREADS ARE CLEAN
3. MOUNT CENTERS	1. WIPE TAPERS IN HEADSTOCK AND TAILSTOCK 2. INSERT DEAD CENTER IN HEADSTOCK SPINDLE 3. INSERT LIVE CENTER IN TAILSTOCK
4. MOUNT MANDREL BETWEEN CENTERS	1. PLACE LATHE DOG ON LARGE END OF MANDREL 2. TIGHTEN SCREW ON FLAT 3. MOUNT MANDREL BETWEEN CENTERS 4. CHECK TAIL OF DOG TO SEE THAT IT IS IN PROPERLY 5. APPLY ONLY ENOUGH TENSION TO HOLD MANDREL SECURELY
5. SET UP TOOL	1. SELECT SHARP TOOL WITH SMALL RADIUS ON NOSE 2. MOUNT TOOL IN IN TOOL HOLDER 3. MOVE TOOL POST TO LEFT SIDE OF COMPOUND REST 4. SWING TOOL HOLDER IN TOOL POST UNTIL TOOL IS PERPENDICULAR TO WORK

5. SET UP TOOL (CON'T.)	5. TIGHTEN TOOL HOLDER
6. MAKE FINAL ADJUSTMENTS	POSITION TOOL

SKETCHES: DRAWING #16: ARBOR COLLAR

REFERENCES: REF. #1, PP. 36-16 TO 36-20
REF. #2, PP. 481-482

TASK SHEET

JOB: EL-4
TASK: 10
PAGE: 1

TASK:	FACE AND CHAMFER ENDS
JOB:	MAKE ARBOR COLLAR
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ENGINE LATHE, FACING TOOL, 10" MILL FILE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. FACE END	1. FACE UNFINISHED END OF HOLE 49/64"
	2. FACE WORK PIECE WHILE IN MANDREL NOTE: BE CAREFUL NOT TO CUT MANDREL
	3. MOVE TOOL AWAY FROM WORK AND TOWARD TAILSTOCK
2. CHAMFER OUTSIDE EDGES	1. LEAVE MACHINE TURNING
	2. PLACE FILE ON OUTSIDE EDGE OF WORK PIECE
	3. HOLD AT 45 DEGREE ANGLE
	4. FILE 1/16" CHAMFER ON EACH END NOTE: FILE A LITTLE TOO DEEP TO ALLOW FOR STOCK REMOVED DURING GRINDING
	5. TURN MACHINE OFF
3. REMOVE SETUP	1. REMOVE MANDREL
	2. REMOVE LATHE DOG
	3. USE BRASS HAMMER TO REMOVE WORK PIECE
	4. REMOVE THE FACE PLATE, WIPE, AND STORE
4. SET UP TO CHAMFER	1. MOUNT UNIVERSAL CHUCK
	2. PLACE WORK PIECE IN CHUCK UNFINISHED END OUT
	3. LEAVE 1/4" OF WORK PIECE EXPOSED
	4. TRUE WORK PIECE
5. CHAMFER INSIDE EDGE	REPEAT TASK 7
6. CLEAN MACHINE	1. REMOVE WORK PIECE

6. CLEAN MACHINE (CON'T.)
   2. BRUSH AND WIPE MACHINE
   3. DISPOSE OF WASTE

ROUTE TO SHAPER

SKETCHES: DRAWING #16: ARBOR COLLAR

REFERENCES: REF. #1, PP. 36-37

JOB SHEET
IN
TURRET LATHE

TL-2

JOB: MAKE ARBOR COLLAR

MATERIALS: TURRET LATHE, FEED FINGERS, COLLETS, BOX TOOL, DRILLS, DRILL HOLDER, STOCK STOP, BORING TOOL, CUT-OFF TOOL, CHAMFERING TOOL, COUNTERSINKING TOOL, CENTERING TOOL, 10" MILL FILE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 36-39. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

TL-2-1 CHECK TURRET LATHE FOR PROPER RUNNING CONDITION, STEEL WASHERS, TL-1-1

TL-2-2 INSTALL PROPER FEED FINGERS AND COLLET, STEEL WASHERS, TL-1-2

TL-2-3 INSTALL TOOLS IN HEXAGON TURRET AND SET STOPS, STEEL WASHERS, TL-1-2

NOTE: TOOL LAYOUT:
- FACE #1 - STOCK STOP
- FACE #2 - CENTER DRILL
- FACE #3 - 1/4" PILOT DRILL
- FACE #4 - 13/16" DRILL
- FACE #5 - BORING TOOL (USE LARGEST AND SHORTEST POSSIBLE)
- FACE #6 - COUNTERSINK (WILL PUT 1/16" CHAMFER IN END OF HOLE

TL-2-4 INSTALL PROPER TOOLS IN TOOL POST TURRET, STEEL WASHERS, TL-1-2
- POSITION #1 - FACING TOOL
- POSITION #2 - TURNING TOOL
- POSITION #3 - 45 DEGREE ANGLE CHAMFERING TOOL
- POSITION #4 - CUT-OFF OR PARTING TOOL

TL-2-5 MACHINE WORK PIECE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. CHECK MATERIAL SUPPORT IF LONG BAR IS USED.
2. OIL RESERVOIRS FOR PROPER LEVEL.
3. COOLANT TANK FOR PROPER LEVEL.
4. PROPER TURRET SETUP.

5. PROPER TOOL POST TURRET SETUP.
6. ALL DIMENSIONS HELD TO SPECIFICATIONS.

TASK SHEET

JOB: TL-2
TASK: 5
PAGE: 1

TASK:	MACHINE WORK PIECE
JOB:	MAKE ARBOR COLLAR
TRADE:	MACHINIST
TOOLS AND MATERIALS:	TURRET LATHE, CENTER DRILL, 1/4" PILOT DRILL, 13/16" DRILL, BORING TOOL, COUNTERSINK, CUT-OFF TOOL, 10" MILL, CHAMFERING TOOL, FACING TOOL, TURNING TOOL, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MAKE FINAL ADJUSTMENTS	1. SET STOCK STOP FOR MATERIAL TO BE 1 1/4" OUT OF COLLET
	2. FEED STOCK OUT TO STOCK STOP
	3. SET SPEED AT 400 RPM
	4. ROTATE TURRET TO CENTER DRILL
2. PERFORM TURRET OPERATION	1. PUT SAFETY GOGGLES ON
	2. START MACHINE
	3. TURN COOLANT PUMP ON
	4. ROTATE TURRET TO CENTER DRILL
	5. CENTER DRILL TO SPOT
	6. ROTATE TURRET TO PILOT DRILL
	7. DRILL PILOT HOLE 1" DEEP
	8. ROTATE TURRET TO 13/16"
	9. DRILL 13/16" HOLE 1" DEEP
	10. ROTATE TURRET TO BORING POSITION NOTE: BE SURE STOP IS SET TO PREVENT TOOL FROM STRIKING BACK OF HOLE
	11. BORE HOLE TO .868" ± .002" NOTE: CHECK DIAMETER AFTER EACH SMALL CUT. SEVERAL ADJUSTMENTS MAY BE REQUIRED TO GET TOOL SET PROPERLY. WHEN TOOL CUTS TO .868" KEEP THE SETTING FOR OTHER COLLARS
	12. ROTATE TURRET TO COUNTERSINK
	13. COUNTERSINK TO 1/16"
	14. BACK TURRET AWAY FROM WORK PIECE

3. PERFORM BOX TOOL OPERATIONS (TOOL POST TURRET)
    1. POSITION TOOL POST TURRET WITH FACING TOOL SET FOR FACING
    2. HOLD CARRIAGE AGAINST STOP
    3. ENGAGE CROSS FEED LEVER
    4. POSITION THE TOOL POST TURRET FOR TURNING
    5. TURN DIAMETER TO 1.387" ± .002" AND 1" LENGTH FROM END
    6. POSITION THE TOOL POST TURRET FOR CHAMFERING
    7. CHAMFER OUTSIDE EDGE SLIGHTLY DEEPER THAN 1/16" TO ALLOW FOR STOCK REMOVED IN GRINDING
    8. POSITION THE TOOL POST TURRET FOR PARTING
    9. PART WORK PIECE 49/64" LONG

       NOTE: BEFORE TOOL COMPLETES THE CUT, USE A FILE TO PUT A 45 DEGREE CHAMFER ON OUTSIDE EDGE SLIGHTLY LARGER THAN 1/16"

       NOTE: COLLET MUST BE CHANGED TO FIT NEW SIZE OF THE WORK PIECE TO CHAMFER INSIDE OF UNFINISHED END
4. INSPECT
    1. DIMENSION "A" - 49/64"
    2. DIMENSION "B" - 1.387"
    3. DIMENSION "C" - .868"
    4. 1/16" CHAMFER

ROUTE TO SHAPER

SKETCHES: DRAWING #16: ARBOR COLLAR

REFERENCES: REF. #1, PP. 36-39

JOB SHEET
IN
SHAPER

S-10

JOB: MAKE ARBOR COLLAR

MATERIALS: ARBOR COLLAR TURNED TO SIZE

TOOLS AND EQUIPMENT: SHAPER, SHAPER VISE, PARALLEL BAR, EXTENSION TOOL HOLDER, 1/8" SQUARE NOSE TOOL, WEDGE AND HAMMER, MILL FILE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB READ REF. #1, PP. 37-11 TO 37-12, REF. #2, PP. 510-512, AND REF. #3, PP. 219-221. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

S-10-1 CHECK MACHINE FOR PROPER RUNNING CONDITION, DRILL DRIFT, S-1-1
S-10-2 SET UP SHAPER
S-10-3 MACHINE WORK PIECE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. OIL RESERVOIRS FILLED TO PROPER LEVEL.
2. PROPER MACHINE SETUP.
3. SMOOTH MACHINE FINISH.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: S-10
TASK: 2
PAGE: 1

TASK: SET UP SHAPER

JOB: MAKE ARBOR COLLAR

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, SHAPER VISE, PARALLEL BAR, EXTENSION TOOL HOLDER, 1/8" SQUARE NOSE TOOL, WEDGE AND HAMMER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP VISE	1. MOUNT VISE ON MACHINE WITH JAWS PARALLEL TO RAM 2. INDICATE VISE TRUE
2. MOUNT WORK PIECE	1. PLACE PROPER PARALLEL BAR IN VISE 2. LAY WORK PIECE IN VISE ON PARALLEL BAR 3. CENTER LINE OF WORK PIECE MUST BE BELOW TOP OF VISE JAWS 4. TIGHTEN VISE
3. MOUNT TOOL IN BORING BAR	1. SELECT OR GRIND A SQUARE, FLAT FACE, 1/8" WIDE TOOL BIT 2. MOUNT TOOL BIT IN BORING BAR 3. MOUNT TOOL POINTING DOWN, (SEE REF. #3, P. 220)
4. MOUNT TOOL HOLDER	1. MOUNT TOOL HOLDER IN CLAPPER BOX TOOL POST 2. TIGHTEN TOOL HOLDER IN TOOL POST 3. PLACE WEDGE BEHIND TOOL HOLDER NOTE: THIS IS DONE TO KEEP THE CLAPPER BOX FROM LIFTING ON THE RETURN STROKE 4. TAP WEDGE DOWN LIGHTLY WITH HAMMER
5. HAND FEED TOOL THROUGH WORK PIECE	1. MOVE TABLE TO POSITION END OF BORING BAR NEAR CENTER OF HOLE 2. SET RAM IN NEUTRAL 3. HAND FEED RAM FORWARD UNTIL TOOL

5. HAND FEED TOOL THROUGH WORK PIECE (CON'T.)	PASSES THROUGH WORK PIECE TO BE SURE IT CLEARS
6. SET RAM	1. SET LENGTH OF STROKE FOR TOOL TO EXTEND 3/4" BEYOND WORK PIECE 2. ADJUST RETURN STROKE FOR TOOL TO EXTEND 1/2" BEYOND WORK PIECE 3. USE SLOW RAM STROKE SPEED 4. USE HAND FEED

SKETCHES: DRAWING #16: ARBOR COLLAR

REFERENCES: REF. #1, PP. 37-11 TO 37-12
REF. #2, PP. 510-512
REF. #3, PP. 219-221

TASK SHEET

JOB: S-10
TASK: 3
PAGE: 1

TASK: MACHINE WORK PIECE

JOB: MAKE ARBOR COLLAR

TRADE: MACHINIST

TOOLS AND MATERIALS: SHAPER, FILE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CUT KEYWAY	1. PUT SAFETY GOGGLES ON 2. START MACHINE 3. MOVE TABLE TO CENTER TOOL NOTE: THE CENTER LINE OF KEYWAY MUST BE PARALLEL TO THE VERTICAL TRAVEL OF THE TOOL 4. FEED TOOL SLOWLY UNTIL IT TOUCHES WORK PIECE 5. TAKE .002" CUT OR LESS PER STROKE 6. CONTINUE CUTTING UNTIL TOOL HAS 100% CLEAN UP ON RADIUS OF WORK PIECE 7. REMOVE EXACTLY .067" FROM POINT OF CLEAN UP NOTE: THIS IS 1/2 WIDTH OF KEYWAY PLUS GRINDING STOCK 8. STOP MACHINE 9. REMOVE WORK PIECE
2. REMOVE BURRS	FILE LIGHTLY
3. INSPECT	CHECK KEYWAY WITH A STANDARD KEY
4. CLEAN MACHINE	1. REMOVE SETUP FROM MACHINE 2. CLEAN TOOLS AND EQUIPMENT AND RETURN TO PROPER PLACE 3. BRUSH AND WIPE MACHINE 4. DISPOSE OF WASTE MATERIAL

ROUTE TO HEAT TREAT
NOTE: HEAT TREAT AS IN PARALLEL BLOCKS, HT-1

SKETCHES: DRAWING #16: ARBOR COLLAR

REFERENCES: REF. #1, PP. 37-11 TO 37-12
REF. #2, PP. 510-512
REF. #3, PP. 219-221

IG-1

JOB SHEET
IN
INTERNAL GRINDER

JOB:	MAKE ARBOR COLLAR
MATERIALS:	HARDENED ARBOR COLLAR
TOOLS AND EQUIPMENT:	INTERNAL GRINDER, UNIVERSAL CHUCK, SMALL INTERNAL GRINDING WHEEL (CENTER BORED TYPE), GO AND NO-GO PLUG GAUGE (±.0002" LIMIT), DIAMOND DRESSER, INSIDE CALIPERS, MICROMETERS, DIAL INDICATOR
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB READ REF. #1, P. 33-6 AND REF. #2, P. 568. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:	IG-1-1	CHECK MACHINE FOR PROPER RUNNING CONDITION
	IG-1-2	SET UP MACHINE
	IG-1-3	GRIND HOLE IN SIZE
	IG-1-4	FACE END

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. OIL RESERVOIRS FILLED TO PROPER LEVEL.
2. PROPER GRINDING WHEEL.
3. FLAWS IN GRINDING WHEEL.
4. PROPER QUILL OR SPINDLE SIZE.
5. GUARDS IN PLACE AND TIGHT.
6. PROPER MACHINE SETUP.
7. HOLD I. D. TO SPECIFICATIONS.
8. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: IG-1
TASK: 1
PAGE: 1

TASK: CHECK MACHINE
JOB: MAKE ARBOR COLLAR
TRADE: MACHINIST
TOOLS AND MATERIALS: INTERNAL GRINDER, OIL CAN, WORK PIECE
TASK BREAKDOWN:

STEPS	KEY POINTS
1. LUBRICATE MACHINE	1. PLACE ONE OR TWO DROPS OF OIL IN EACH OIL CAP 2. FILL OIL RESERVOIR TO THE PROPER LEVEL 3. OIL WAYS LIGHTLY
2. CHECK GUARDS	ALL GUARDS NOTE: CHUCK GUARD MAY BE REMOVED DURING SETUP. REPLACE BEFORE GRINDING
3. CHECK DOGS	CHECK REVERSING DOGS TO BE SURE THEY REVERSE SPINDLE PROPERLY

SKETCHES: DRAWING #16: ARBOR COLLAR

REFERENCES: REF. #1, P. 33-6
REF. #2, P. 568

TASK SHEET

JOB: IG-1
TASK: 2
PAGE: 1

TASK: SET UP MACHINE

JOB: MAKE ARBOR COLLAR

TRADE: MACHINIST

TOOLS AND MATERIALS: INTERNAL GRINDER, UNIVERSAL CHUCK, DIAL INDICATOR, DIAMOND DRESSER, GRINDING WHEEL, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT GRINDING WHEEL	1. SELECT PROPER WHEEL
	a. CENTERGROUND TYPE
	b. ABOUT 2/3 DIAMETER OF HOLE TO BE GROUND
	c. SIMILAR TO NORTON 3846-L5 BE
	2. MOUNT WHEEL ON END OF QUILL OR SPINDLE WITH COUNTERBORED END OUT
	3. TIGHTEN HOLDING WHEEL NOTE: WHEEL WILL BREAK IF TIGHTENED TOO TIGHT
2. DRESS GRINDING	1. MOUNT DIAMOND IN DIAMOND HOLDER
	2. PUT ON SAFETY GOGGLES
	3. START SPINDLE MOTOR
	4. MOVE WHEEL IN UNTIL IT TOUCHES DIAMOND
	5. SET TABLE TRAVEL ON 6" PER MINUTE
	6. FEED SPINDLE BOTH DIRECTIONS ON DIAMOND
	7. REMOVE .004" PER CUT UNTIL WHEEL IS TRUE
	8. STOP SPINDLE
	9. REMOVE DIAMOND AND HOLDER
3. MOUNT WORK PIECE	1. USE CHUCK WRENCH TO OPEN JAWS 1 1/2"
	2. MOUNT WORK PIECE IN CHUCK WITH HOLE PARALLEL TO WAYS
	3. ALLOW 3/8" TO EXTEND OUT OF CHUCK
	4. TIGHTEN CHUCK JAWS EVENLY

4. TRUE WORK PIECE	1. MOVE TABLE TOWARD WHEEL UNTIL THE WORK PIECE AND WHEEL ARE 1/4" APART 2. ROTATE CHUCK BY HAND 3. LOOSEN ONE JAW AND TIGHTEN OPPOSING JAW TO MOVE PART IN DESIRED DIRECTION 4. ADJUST WORK PIECE IN CHUCK UNTIL IT APPEARS TRUE 5. MOUNT DIAL INDICATOR ON SPINDLE OR USE SURFACE GUAGE 6. MOUNT HOLE ATTACHMENT ON INDICATOR 7. POSITION END OF HOLE ATTACHMENT 1/2" INSIDE HOLE AND AGAINST SIDE NEAREST OPERATOR 8. REVOLVE CHUCK BY HAND 9. ADJUST JAWS TO TRUE WORK PIECE
5. SET REVERSING DOGS	1. SET DOGS TO REVERSE AFTER WHEEL HAS CLEARED EACH END OF THE WORK PIECE 2. MOVE SPINDLE UNTIL WHEEL IS CENTERED IN WORK PIECE 3. BE SURE THE WHEEL IS NOT TOUCHING WORK PIECE 4. RUN TABLE BACK AND FORTH SEVERAL TIMES TO CHECK REVERSING 5. RESET DOGS IF NECESSARY
6. SET SPEED	SET AT 400 RPM

SKETCHES: DRAWING #16: ARBOR COLLAR

REFERENCES: REF. #1, P. 33-6
REF. #2, P. 568

TASK SHEET

JOB: IG-1
TASK: 3
PAGE: 1

TASK: GRIND HOLE TO SIZE

JOB: MAKE ARBOR COLLAR

TRADE: MACHINIST

TOOLS AND MATERIALS: INTERNAL GRINDER, MICROMETER, PLUG GAUGE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. PREPARE TO GRIND	1. REPLACE ANY GUARDS REMOVED FOR SETUP
	2. PUT SAFETY GOGGLES ON
	3. START SPINDLE
	4. START HEADSTOCK
	5. START AUTOMATIC FEED
2. GRIND WORK PIECE	1. FEED WHEEL TOWARD OPERATOR UNTIL IT TOUCHES WORK PIECE
	2. REMOVE .0005" OR LESS FOR EVERY FOUR OR FIVE ROUND TRIPS WITH THE GRINDING WHEEL
	3. STOP MACHINE AND CHECK INSIDE DIAMETER (I.D.) SEVERAL TIMES TO HOLD CLOSE TOLERANCE
	4. CONTINUE GRINDING UNTIL DIMENSION HELD
	5. CHECK WITH PLUG GAUGE

SKETCHES: DRAWING #16: ARBOR COLLAR

REFERENCES: REF. #1, P. 33-6
REF. #2, P. 568

TASK SHEET

JOB: IG-1
TASK: 4
PAGE: 1

TASK: FACE END

JOB: MAKE ARBOR COLLAR

TRADE: MACHINIST

TOOLS AND MATERIALS: INTERNAL GRINDER, MICROMETER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. PREPARE TO GRIND FACE	1. STOP TABLE TRAVEL WITH GRINDING WHEEL 1/4" FROM FACE OF THE WORK PIECE 2. PUT SAFETY GOGGLES ON 3. START SPINDLE 4. START HEALSTOCK
2. GRIND FACE	1. MOVE GRINDING WHEEL OUT BY HAND UNTIL FACE COVERS ENTIRE EDGE OF WORK PIECE NEAREST OPERATOR 2. MOVE TABLE BY HAND UNTIL WORK PIECE TOUCHES WHEEL 3. FEED WORK PIECE SLOWLY INTO FACE OF WHEEL FOR 100% CLEAN UP 4. REMOVE .007" FROM END 5. TURN TABLE HAND WHEEL TO MOVE HEADSTOCK AWAY FROM WHEEL 6. STOP MACHINE 7. REMOVE WORK PIECE
3. CLEAN MACHINE	1. BRUSH AND WIPE MACHINE 2. AIR IS NOT TO BE USED

ROUTE TO CYLINDRICAL GRINDER

SKETCHES: DRAWING #16: ARBOR COLLAR

REFERENCES: REF. #1, P. 33-6
REF. #2, P. 568

CG-3

JOB SHEET
IN
CHLINDRICAL GRINDER

JOB: MAKE ARBOR COLLAR

MATERIALS: HARDENED STEEL ARBOR COLLAR INTERNALLY GROUND

TOOLS AND EQUIPMENT: CYLINDRICAL GRINDER, DIAMOND DRESSER, LATHE MANDREL, GRINDER DOG, DIAL INDICATOR, MICROMETER, HONE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 33-1 TO 33-15 AND REF. #2, PP. 566-567. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

CG-3-1 CHECK MACHINE FOR PROPER RUNNING CONDITION, TEST BAR, CG-1-1

CG-3-2 SET UP MACHINE FOR GRINDING, TEST BAR, CG-1-2

NOTE: SEE LATHE OPERATING THIS JOB FOR INFORMATION ABOUT MOUNTING WORK PIECE ON MANDREL

CG-3-3 GRIND WORK PIECE TO SIZE, TEST BAR, CG-1-3

NOTE: HOLD O.D. 1.375" ± .001"

ROUTE WORK TO SURFACE GRINDER

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. OIL RESERVOIRS FILLED TO PROPER LEVEL.
2. COOLANT RESERVOIR FILLED.
3. SUFFICIENT COOLANT FLOW.
4. FLAWS IN GRINDING WHEEL.
5. TABLE FEED REVERSING DOGS.
6. GUARDS IN PLACE AND TIGHT.
7. PROPER MACHINE SETUP.
8. DIMENSIONS HELD TO SPECIFICATIONS.
9. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

SG-7

JOB SHEET
IN
SURFACE GRINDER

JOB:	MAKE ARBOR COLLAR	
MATERIALS:	HARDENED ARBOR COLLAR GROUND INTERNALLY ON O. D., AND ON ONE END	
TOOLS AND EQUIPMENT:	SURFACE GRINDER, GRINDING WHEEL, MAGNETIC CHUCK, DIAMOND DRESSER, V BLOCK, MICROMETER	
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 33-1 TO 33-15 AND REF. #2, PP. 565-581. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.	
PROCEDURES AND/OR TASKS:	SG-7-1	CHECK MACHINE FOR PROPER RUNNING CONDITION, PARALLEL BLOCKS, SG-1-1
	SG-7-2	DRESS THE GRINDING WHEEL, PARALLEL BLOCKS, SG-1-2
	SG-7-3	GRIND WORK PIECE
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK. 1. ELECTROMAGNET HOLDING POWER. 2. CORRECT SETUP. 3. GRINDING WHEEL SHARP AND FREE OF FLAWS. 4. ALL DIMENSIONS HELD TO SPECIFICATIONS. 5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.	

JOB: SG-7
TASK: 3
PAGE: 1

TASK SHEET

TASK: GRIND WORK PIECE

JOB: MAKE ARBOR COLLAR

TRADE: MACHINIST

TOOLS AND MATERIALS: SURFACE GRINDER, GRINDING WHEEL, MAGNETIC CHUCK, V BLOCKS, MICROMETER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK	1. WIPE CHUCK CLEAN WITH PALM OF HAND
	2. SET WORK PIECE IN CENTER OF CHUCK GROUND END DOWN
	3. PLACE SUPPORT BLOCK AGAINST LEFT SIDE OF WORK PIECE NOTE: THE MAGNETIC CHUCK HAS LITTLE HOLDING POWER ON THIN EDGE OF WORK PIECE, WITHOUT SUPPORT BLOCKWORK PIECE COULD BE THROWN OFF BY GRINDING WHEEL
	4. TURN THE ELECTROMAGNETIC CHUCK POWER ON
2. GRIND END	1. LOWER GRINDING WHEEL TO WITHIN 1/16" OF WORK
	2. PUT SAFETY GOGGLES ON
	3. TURN SPINDLE ON
	4. USE THE ELEVATING HANDWHEEL TO LOWER WHEEL UNTIL IT BEGINS TO CUT
	5. USE TABLE HAND CRANK TO FEED TABLE LONGITUDINALLY UNDER WHEEL AT A STEADY RATE
	6. USE TABLE CROSSFEED HANDWHEEL TO MOVE WORK ACROSS WHEEL
	7. AFTER CLEAN UP, LOWER WHEEL .002" PER CUT
	8. HOLD LENGTH TO .750" ± .0002"
	9. STOP MACHINE
	10. TURN ELECTROMAGNETIC CHUCK OFF

2.	GRIND END (CON'T.)	11.	REMOVE WORK PIECE
3.	CLEAN MACHINE	1. 2. 3. 4.	BRUSH AND WIPE MACHINE CLEAN AND STORE SUPPORT BLOCK BRUSH AND WIPE CHUCK AIR SHOULD NOT BE USED FOR CLEANING
4.	INSPECT	1. 2. 3. 4. 5.	DIMENSION "B" - 1.375" DIMENSION "A" - .750" DIMENSION "C" - .8752" 1/16" X 45° CHAMFER SMOOTH FINISH

SKETCHES: DRAWING #16: ARBOR COLLAR

REFERENCES: REF. #1, PP. 33-1 TO 33-15
REF. #2, PP. 565-581

MACHINE SHOP JIG BUSHING

ENGINE LATHE	5
TURRET LATHE	3
HEAT TREAT	7
INTERNAL GRINDER	2
CYLINDRICAL GRINDER	4
DRILL PRESS	7

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND CONSTRUCT A JIG BUSHING ACCORDING TO SPECIFICATIONS; USING TOOLS, MATERIALS, MACHINES, AND EQUIPMENT AS CALLED FOR IN THE JOB.

CHECKING STANDARDS

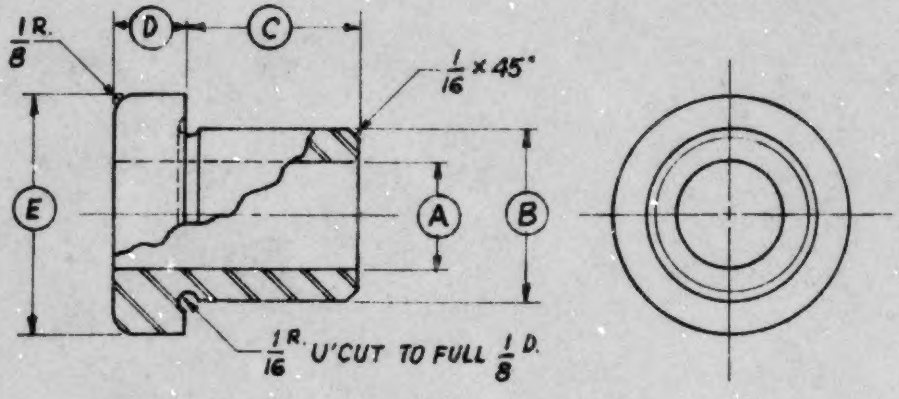
1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.

NOTE: THE TASK SHEETS FOR THIS JOB ARE DESIGNED FOR REF. #4, MEDIUM LENGTH BUSHING AS ILLUSTRATED IN DRAWING #17. IF OTHER SIZES ARE DESIRED, DIMENSIONS MUST BE CHANGED ACCORDINGLY.



*ALLOW .008 STOCK FOR INTERNAL GRINDING.
ALLOW .0001 FOR LAPPING HOLE.
GRINDING TOLERANCE FOR HOLE: MIN. .0001-MAX. .0004

**ALLOW .012 STOCK ON BODY O.D. FOR GRINDING.
GRIND BODY O.D. TO FIT HOLE IN DRILL JIG.

REF. NO.	DRILL SIZE *A		BODY **B	LENGTH C			HEAD	
	FROM	TO	NOM.	SHORT	MED.	LONG	D	E
1	17/64	5/16	1/2	5/16	1/2	3/4	1/4	13/16
2	21/64	1/2	3/4	1/2	3/4	1	1/4	1 1/16
3	33/64	3/4	1	3/4	1	1 3/8	3/8	1 7/16
4	49/64	1	1 3/8	3/4	1	1 3/8	3/8	1 13/16

DRAWING NO. 17

JIG BUSHING

TOLERANCES UNLESS OTHERWISE NOTED

BENCH JOB NO. 6
LATHE JOB NO. 5
TURRET LATHE JOB NO. 3
CYL. GRINDER JOB NO. 4
INT. GRINDER JOB NO. 2

MATERIAL: TOOL STEEL
FINISH: HARDEN, GRIND & LAP
SCALE: NONE

FRACTIONS - ± 1/64"
DECIMAL - ± .005"
ANGLES - ± 1/4°

EL-5

JOB SHEET
IN
ENGINE LATHE

JOB: MAKE JIG BUSHING

MATERIALS: BAR OF 1 7/8" ROUND TOOL STEEL

TOOLS AND EQUIPMENT: ENGINE LATHE, INDEPENDENT CHUCK, CENTERING TOOL, LATHE TOOL HOLDER, BORING TOOL, CUT-OFF TOOL, MICROMETER, MILL FILE, DIAL INDICATOR

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 36-1 TO 36-44 AND REF. #2, PP. 462-493. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

EL-5-1	CHECK MACHINE FOR PROPER RUNNING CONDITION, STUD, EL-1-1
EL-5-2	MOUNT WORK IN INDEPENDENT CHUCK
EL-5-3	MACHINE WORK PIECE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. OIL RESERVOIRS FILLED TO PROPER LEVEL.
2. PROPER MACHINE SETUP.
3. ACCURACY OF CENTERS.
4. ALL DIMENSIONS HELD TO SPECIFICATIONS.
5. SMOOTH MACHINE FINISH.
6. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: EL-5
TASK: 2
PAGE: 1

TASK:	MOUNT WORK IN INDEPENDENT CHUCK
JOB:	MAKE JIG BUSHING
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ENGINE LATHE, INDEPENDENT CHUCK, DIAL INDICATOR, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHUCK BAR STOCK	1. USE CHUCK WRENCH TO OPEN JAWS 1 1/2"
	2. PLACE WORK STOCK IN CHUCK
	3. ALLOW 1 5/8" TO EXTEND OUT OF THE CHUCK
	4. TIGHTEN CHUCK JAWS EVENLY
2. TRUE WORK	1. ATTACH THE DIAL INDICATOR TO TOOL HOLDER IN TOOL POST
	2. ROTATE CHUCK BY HAND
	3. LOOSEN ONE JAW AND TIGHTEN OPPOSING JAW TO MOVE MATERIAL IN DESIRED DIRECTION
	4. CONTINUE UNTIL TRUE

SKETCHES: DRAWING #17: JIG BUSHING

REFERENCES: REF. #2, PP. 471-474

TASK SHEET

JOB: EL-5
TASK: 3
PAGE: 1

TASK: MACHINE WORK PIECE

JOB: MAKE JIG BUSHING

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, TURNING TOOL, 1/16" RADII TOOL, 31/32" TAPER SHANK DRILL, BORING TOOL, BORING BAR, MILL FILE, OIL CAN, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP TOOL	1. SELECT SHARP TURNING TOOL 2. MOUNT TOOL IN TOOL HOLDER 3. PLACE TOOL HOLDER IN TOOL POST 4. SWING TOOL IN TOOL HOLDER UNTIL TOOL IS PERPENDICULAR TO WORK PIECE 5. TIGHTEN TOOL HOLDER IN TOOL POST WITH SET SCREW NOTE: THE TOOL POST SHOULD BE MOUNTED ON LEFT SIDE OF COMPOUND REST
2. TURN LARGE O.D.	1. PUT SAFETY GOGGLES ON 2. TURN MACHINE ON 3. TURN TO 1 13/16" DIAMETER AND 1 1/2" LENGTH FROM END OF WORK PIECE NOTE: THIS DIAMETER WILL NOT BE GROUND NOTE: ANY TIME THERE ARE TWO DIAMETERS TO BE TURNED, STOP MACHINE AND CHECK WITH MICROMETERS WHILE TOOL IS STILL IN THE SMALLER DIAMETER, BACK THE TOOL OUT TO PREVENT SCRAPPING THE PIECE
3. TURN SMALL O.D.	1. SET TOOL TO CUT A SQUARE CORNER 2. TURN TO 1.390" O.D. 3. HOLD 1 1/32" LENGTH FROM END OF WORK PIECE NOTE: THIS LEAVES 1/32" FOR FACING

4. CHAMFER	1. LEAVE CHUCK TURNING 2. PLACE FILE ON OUTSIDE EDGE OF THE WORK PIECE 3. HOLD AT 45 DEGREE ANGLE 4. FILE 1/16" CHAMFER ON END NOTE: FILE A LITTLE TOO DEEP TO ALLOW FOR STOCK REMOVED DURING GRINDING 5. TURN MACHINE OFF
5. SET UP DRILL	1. SELECT A SHARP 31/32" TAPER SHANK DRILL 2. INSERT DRILL INTO TAILSTOCK WITH A QUICK JAB 3. USE DRILL SLEEVE IF NECESSARY 4. SLIDE TAILSTOCK TOWARD HEADSTOCK UNTIL DRILL IS 1/4" FROM WORK PIECE 5. LOCK TAILSTOCK WITH LOCKING LEVER
6. DRILL HOLE	1. PUT SAFETY GOGGLES ON 2. OIL END OF DRILL 3. TURN MACHINE ON 4. FEED DRILL INTO WORK PIECE USING TAILSTOCK HANDWHEEL 5. WITHDRAW AND OIL DRILL EVERY 1/4" 6. CONTINUE DRILLING UNTIL HOLE IS 1 1/2" DEEP FROM LIP OF DRILL 7. REMOVE DRILL 8. TURN MACHINE OFF
7. SET UP BORING BAR	1. SELECT PROPER SIZE BAR WITH SHARP TOOL 2. MOUNT BAR PARALLEL TO WAYS WITH TOOL TOWARD WORK PIECE 3. TOOL SHOULD BE ON SIDE OF THE BAR NEAREST OPERATOR
8. BORE HOLE	1. PUT SAFETY GOGGLES ON 2. TURN MACHINE ON FORWARD 3. MOVE CARRIAGE UNTIL TOOL IS INSIDE HOLE BUT NOT TOUCHING 4. BRING CROSS SLIDE OUT UNTIL TOOL BEGINS TO TOUCH 5. MOVE TOOL OUT OF WORK PIECE 6. USE DIAL TO BRING CROSS SLIDE OUT .010"

8. BORE HOLE (CON'T.)	7. SQUIRT SOME OIL IN HOLE 8. HAND FEED TOOL INTO WORK PIECE NOTE: BE SURE TOOL DOES NOT HIT BACK END OF HOLE 9. BORE HOLE TO .990" TO LEAVE .010" FOR GRINDING
9. CUT RADIUS ON I. D.	1. SELECT RADII TOOL WITH 1/16" CONCAVE RADIUS GROUND ON SIDE 2. MOUNT TOOL IN TOOL HOLDER 3. MOUNT TOOL HOLDER IN TOOL POST 4. TURN TABLE AND CROSS FEED HANDLES TO POSITION TOOL AT END OF THE WORK PIECE AND ON CENTERLINE WITH TOOL RADII ON EDGE OF WORK PIECE 5. PUT SAFETY GOGGLES ON 6. TURN MACHINE ON FORWARD 7. HAND FEED TOOL OUT TO OBTAIN DESIRED RADIUS NOTE: MOST SMALL I. D. RADII CAN BE PUT ON BY USING A BURRING TOOL AND FREE HAND RADIUS 8. TURN MACHINE OFF
10. CLEAN MACHINE	BRUSH AND WIPE

ROUTE TO HEAT TREAT

SKETCHES: DRAWING #17: JIG BUSHING

REFERENCES: REF. #1, P. 36-35
REF. #2, PP. 479-486

OPTIONAL TL-2

JOB SHEET
IN
TURRET LATHE

JOB: MAKE JIG BUSHING

MATERIALS: BAR OF 1 7/8" ROUND TOOL STEEL

TOOLS AND EQUIPMENT: TURRET LATHE, FEED FINGERS, COLLETS, BOX TURNING TOOL, 31/32" DRILL, CENTERING TOOL, NECKING TOOL, CUT-OFF TOOL, MICROMETER, BORING TOOL, STOCK STOP, FILE

GENERAL INSTRUCTIONS:

TL-2-1 CHECK MACHINE FOR PROPER RUNNING CONDITION, STEEL WASHERS, TL-1-1

TL-2-2 SET UP TURRET LATHE, STEEL WASHERS, TL-1-2

- a. INSTALL FEEDER FINGERS
- b. INSTALL COLLET
- c. SET UP STEEL BAR IN MACHINE SPINDLE
- d. SET FEED AT .002" PER REVOLUTION AND SPEED AT 80 RPM

  NOTE: HIGH CARBON STEEL MUST BE TURNED AT SLOWER SPEEDS

TL-2-3 MACHINE JIG BUSHING

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. OIL RESERVOIRS AT PROPER OPERATING LEVEL.
2. PROPER MACHINE SETUP.
3. PROPER MATERIAL SETUP.
4. ALL DIMENSIONS HELD TO SPECIFICATIONS.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: TL-2
TASK: 3
PAGE: 1

TASK: MACHINE JIG BUSHING

JOB: MAKE JIG BUSHING

TRADE: MACHINIST

TOOLS AND MATERIALS: TURRET LATHE, CENTER DRILL, 1/4" PILOT DRILL, 31/32" DRILL, BORING TOOL, CUT-OFF TOOL, 1/8" RADIUS TOOL, 1/16" RADIUS TOOL, FACING TOOL, TURNING TOOL, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. PERFORM TURRET OPERATION	1. PUT SAFETY GOGGLES ON
	2. START MACHINE
	3. ROTATE TURRET TO CENTER DRILL
	4. CENTER DRILL
	5. ROTATE TURRET TO PILOT DRILL
	6. DRILL PILOT HOLE 1" DEEP
	7. ROTATE TURRET TO 31/32" DRILL
	8. DRILL HOLE 1 1/16" DEEP
	9. ROTATE TURRET TO BORING POSITION
	10. BORE HOLE TO .990" ± .002"
2. PERFORM BORE TOOL	1. TURN "F" DIMENSION TO 1 13/16" DIAMETER
	2. TURN "B" DIAMETER TO 1.390" AND 1" LENGTH NOTE: THIS LEAVES .015" GRINDING STOCK
	3. CHAMFER END 1/16" X 45°
	4. SET PARTING TOOL AGAINST SHOULDER
	5. HAND FEED IN .062" BY DIAL AFTER POINT TOUCHES TO MAKE UNDERCUT
	6. SET PARTING TOOL STOP TO CUT OFF MATERIAL 1 3/8" TOTAL LENGTH NOTE: IF SEVERAL BUSHINGS ARE TO BE MADE, IT MAY BE NECESSARY TO READJUST STOPS
	7. STOP MACHINE
	8. REMOVE MATERIALS

3.	SET UP TO MACHINE 1/8" RADII	1.	MOUNT PROPER COLLET TO HOLD THE SMALL DIAMETER OF WORK PIECE
		2.	MOUNT WORK PIECE IN COLLET
		3.	TIGHTEN COLLET
		4.	SET UP 1/8" RADII TOOL IN POST TURRET IN PLACE OF TURNING TOOL
4.	MACHINE OUTSIDE RADIUS	1.	TURN MACHINE ON FORWARD
		2.	TURN 1/8" RADIUS ON OUTSIDE OF THE LARGE DIAMETER
		3.	TURN MACHINE OFF
5.	SET UP TO MACHINE 1/16" RADII	1.	SELECT TOOL WITH 1/16" CONCAVE RADIUS GROUND ON SIDE
		2.	MOUNT TOOL
		3.	TURN TABLE AND CROSS FEED HANDLES TO POSITION TOOL AT INSIDE EDGE OF WORK PIECE
6.	MACHINE INSIDE RADIUS	1.	TURN MACHINE ON FORWARD
		2.	HAND FEED TOOL OUT TO OBTAIN 1/16" RADIUS
		3.	TURN MACHINE OFF NOTE: MOST SMALL I. D. RADII CAN BE MADE USING A BURRING TOOL AND A FREE HAND RADIUS
7.	CLEAN MACHINE		BRUSH AND WIPE MACHINE
8.	INSPECT	1.	"A" - UNDER 1" FOR GRINDING
		2.	"B" - OVER 1 3/8" FOR GRINDING
		3.	"C" - 1"
		4.	"D" - 3/8"
		5.	"F" - 1 13/16"
		6.	1/16" CHAMFER
		7.	1/8" RADII
		8.	1/8" X 1/16" UNDERCUT

ROUTE WORK PIECE TO HEAT TREAT

SKETCHES: DRAWING #17: JIG BUSHING

REFERENCES: REF. #1, P. 36-39

JOB SHEET
IN
HEAT TREATING

JOB: MAKE JIG BUSHING

MATERIALS: TOOL STEEL BUSHING TURNED AND DRILLED

TOOLS AND EQUIPMENT: BLAST FURNACE, QUENCHING SLOUTION, SAFETY EQUIPMENT

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 31-1 TO 31-9. CHECK WITH INSTRUCTOR AT FREQUENT INTERVALS.

PROCEDURES AND/OR TASKS:

HT-7-1	PREPARE FURNACE FOR HEAT TREATING, PARALLEL BLOCKS, HT-1-1 NOTE: HIGH CARBON STEEL WILL NOT NEED CARBURIZING
HT-7-2	HEAT TREAT BUSHING, PARALLEL BLOCKS, HT-1-2 NOTE: HEAT TO DEEP CHERRY RED AND QUENCH IN CLEAN WATER ROUTE WORK TO INTERNAL GRINDER

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. PROPER FURNACE SETTING.
2. PROPER AIR FLOW.
3. EXHAUST SYSTEM.
4. HEAT TO DEEP CHERRY RED.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

IG-2

JOB SHEET
IN
INTERNAL GRINDER

JOB:	MAKE JIG BUSHING
MATERIALS:	HARDENED TOOL STEEL BUSHING
TOOLS AND EQUIPMENT:	INTERNAL GRINDER, UNIVERSAL CHUCK, GO AND NO-GO PLUG GAUGE, DIAMOND DRESSER, INSIDE CALIPERS, MICROMETERS
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB REVIEW REF. #1, P. 33-6 AND REF. #2, P. 568. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.
PROCEDURES AND/OR TASKS:	IG-2-1 CHECK MACHINE FOR PROPER RUNNING CONDITION, ARBOR COLLAR, IG-1-1 IG-2-2 SET UP MACHINE, ARBOR COLLAR, IG-1-2 IG-2-3 GRIND HOLE TO SIZE, ARBOR COLLAR, IG-1-3 NOTE: HOLE WILL BE LAPPED LATER. HOLD I. D. $^{+.0004}_{-.0001}$
CHECK POINTS:	STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK. 1. OIL RESERVOIRS FILLED TO PROPER LEVEL. 2. PROPER GRINDING WHEEL. 3. FLAWS IN GRINDING WHEEL. 4. PROPER QUILL OR SPINDLE SIZE. 5. GUARDS IN PLACE AND TIGHT. 6. PROPER MACHINE SETUP. 7. HOLD I. D. TO SPECIFICATIONS. 8. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

CG-4

JOB SHEET
IN
CYLINDRICAL GRINDER

JOB:	MAKE JIG BUSHING
MATERIALS:	HARDENED TOOL STEEL JIG BUSHING WITH HOLE GROUND TO SIZE
TOOLS AND EQUIPMENT:	CYLINDRICAL GRINDER, DIAMOND DRESSER, LATHE MANDREL, GRINDER DOG, MICROMETER
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 33-1 TO 33-15 AND REF. #2, PP. 566-567. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:	CG-4-1	CHECK MACHINE FOR PROPER RUNNING CONDITION, TEST BAR, CG-1-1
	CG-4-2	DRESS GRINDING WHEEL, TEST BAR, CG-1-2
	CG-4-3	MOUNT WORK PIECE ON MANDREL, ARBOR COLLAR, EL-4-8 NOTE: LARGE END OF BUSHING GOES ON MANDREL FIRST
	CG-4-4	MOUNT WORK PIECE BETWEEN CENTERS, TEST BAR, CG-1-2
	CG-4-5	GRIND WORK PIECE TO SIZE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. OIL RESERVOIRS FILLED TO OPERATING LEVEL.
2. COOLANT RESERVOIR FILLED TO PROPER LEVEL.
3. COOLANT FLOW SUFFICIENT FOR JOB.
4. WHEEL TRUE AND FREE OF FLAWS.
5. TABLE FEED REVERSING DOGS FUNCTIONING PROPERLY.
6. GUARDS IN PLACE AND TIGHT.
7. PROPER MACHINE SETUP.
8. DIMENSIONS HELD TO SPECIFICATIONS.
9. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: CG-4
TASK: 5
PAGE: 1

TASK: GRIND WORK PIECE TO SIZE
JOB: MAKE JIG BUSHING
TRADE: MACHINIST
TOOLS AND MATERIALS: CYLINDRICAL GRINDER, LATHE MANDREL, GRINDER DOG, MICROMETER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION WHEEL	1. MOVE TABLE AND GRINDING WHEEL TO POSITION FACE OF WHEEL 1/16" FROM WORK PIECE
	2. PLACE EDGE OF WHEEL OVER UNDERCUT
	NOTE: REVERSING DOGS WILL NOT BE USED BECAUSE THE FACE OF MOST GRINDING WHEELS ARE 1" OR MORE WIDE
2. GRIND O. D.	1. PUT ON SAFETY GOGGLES
	2. TURN HEADSTOCK ON
	3. TURN COOLANT PUMP ON
	4. TURN WHEEL ON
	5. MOVE WHEEL IN UNTIL IT TOUCHES WORK PIECE
	6. GRIND TO 100% CLEAN UP
	7. BACK WHEEL AWAY FROM WORK PIECE
	8. TURN HEADSTOCK OFF
	9. TURN COOLANT PUMP OFF
	10. USE MICROMETER TO CHECK WORK FOR TAPER AND ADJUST IF NECESSARY
	11. CONTINUE GRINDING
	12. STOP THE MACHINE FREQUENTLY AND CHECK O. D. WITH MICROMETER
	13. HOLD O. D. TO 1.375 ± .0002"
	14. BACK GRINDING WHEEL AWAY FROM WORK PIECE
3. GRIND SHOULDER	1. MOVE GRINDING WHEEL TO WITHIN .0005" OF FINISH CUT ON O. D.

3. GRIND SHOULDER (CON'T.)	2. SLOWLY HAND FEED TABLE TO THE RIGHT UNTIL WORK PIECE TOUCHES SIDE OF WHEEL 3. TAP THE FEED HANDLE GENTLY WITH HAND TO MOVE WORK SLOWLY INTO THE WHEEL 4. CONTINUE TO GRIND UNTIL FACE IS CLEANED UP 5. STOP MACHINE 6. REMOVE WORK PIECE
4. CLEAN MACHINE	1. BRUSH AND WIPE MACHINE 2. WIPE AND STORE MANDREL

ROUTE WORK TO DRILL PRESS FOR LAPPING

SKETCHES: DRAWING #17: JIG BUSHING

REFERENCES: REF. #1, PP. 33-1 TO 33-15
REF. #2. PP. 566-567

DP-7

JOB SHEET
IN
DRILL PRESS

JOB: MAKE JIG BUSHING

MATERIALS: JIG BUSHING, HARDENED AND GROUND WITH .0001" STOCK LEFT FOR LAPPING

TOOLS AND EQUIPMENT: DRILL PRESS, DRILL CHUCK AND KEY, LAPPING TOOL, LAPPING COMPOUND, SQUIRT CAN OF KEROSENE, PLUG GAUGE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 34-1 TO 34-24 AND REF. #2, PP. 203-228. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

DP-7-1	CHECK DRILL PRESS FOR PROPER RUNNING CONDITION, CLAMP STRAP, DP-1-1
DP-7-2	SET UP DRILL PRESS FOR LAPPING
DP-7-3	LAP BUSHING TO SIZE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. PROPER MACHINE SETUP.
2. PROPER LAPPING COMPOUND FOR THE JOB.
3. ALL DIMENSIONS HELD TO SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: DP-7
TASK: 2
PAGE: 1

TASK:	SET UP DRILL PRESS FOR LAPPING
JOB:	MAKE JIG BUSHING
TRADE:	MACHINIST
TOOLS AND MATERIALS:	DRILL PRESS, DRILL CHUCK AND KEY, 1" LAPPING TOOL, LAPPING COMPOUND, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SELECT LAP	1. SELECT A 1" LAP 2. CHECK CONDITION OF HONES 3. CLEAN HONES IF NECESSARY
2. SET UP LAP	1. MOUNT CHUCK IN DRILL PRESS SPINDLE 2. INSERT SHANK OF LAP IN CHUCK 3. TIGHTEN CHUCK WITH KEY NOTE: BE SURE TO REMOVE KEY
3. PUT LAPPING COMPOUND ON LAP	1. PLACE SMALL AMOUNT OF LAPPING COMPOUND ON LAP 2. USE A COMPOUND SIMILAR TO CARBORUNDUM #R-9 3. SMOOTH COMPOUND EVENLY OVER THE LAPPING HONES

SKETCHES: DRAWING #17: JIG BUSHING

REFERENCES: REF. #1, PP. 34-1 TO 34-24
REF. #2, PP. 203-228

TASK SHEET

JOB: DP-7
TASK: 3
PAGE: 1

TASK: LAP BUSHING TO SIZE

JOB: MAKE JIG BUSHING

TRADE: MACHINIST

TOOLS AND MATERIALS: DRILL PRESS, DRILL CHUCK AND KEY, 1" LAPPING TOOL, LAPPING COMPOUND, PLUG GAUGE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LAP BUSHING	1. PLACE BUSHING ON LAP AND HOLD
	2. EXPAND THE LAP HONES UNTIL THEY TOUCH SIDES OF WORK PIECE
	3. PUT SAFETY GOGGLES ON
	4. START MACHINE
	5. MOVE BUSHING UP AND DOWN ON HONES BY HAND UNTIL PROPER SIZE IS OBTAINED
	6. BUSHING SHOULD NOT BE ALLOWED TO GET HOT WHILE LAPPING
	7. CLEAN BUSHING HOLE WITH KEROSENE BEFORE CHECKING SIZE
	8. ADD COMPOUND TO LAP IF NECESSARY
	9. STOP MACHINE
2. CLEAN UP LAP	1. REMOVE LAP FROM MACHINE
	2. WASH LAP THOROUGHLY WITH KEROSENE
	3. STORE LAP IN PROPER PLACE
3. CLEAN MACHINE	1. REMOVE CHUCK, CLEAN, AND STORE
	2. WIPE MACHINE THOROUGHLY
4. INSPECT	1. DIMENSION "A" - 1" ± .0002"
	2. DIMENSION "B" - 1.375" ± .0002"
	3. DIMENSION "F" - 1 13/16" ± .1/64"
	4. DIMENSION "C" - 1" ± 1/64"
	5. DIMENSION "D" - 3/8" ± 1/64"
	6. 1/16" RADIUS
	7. 1/8" RADIUS
	8. 1/8" X 1/16" UNDERCUT

SKETCHES: DRAWING #17: JIG BUSHING

REFERENCES: REF. #2, PP. 127-128

MACHINE SHOP PUNCHES - PRICK AND CENTER

ENGINE LATHE 6

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIAL, READ DRAWINGS, AND CONSTRUCT PUNCHES ACCORDING TO SPECIFICATIONS; USING TOOLS, MACHINES, EQUIPMENT, AND MATERIALS CALLED FOR IN THE JOB.

CHECKING STANDARDS

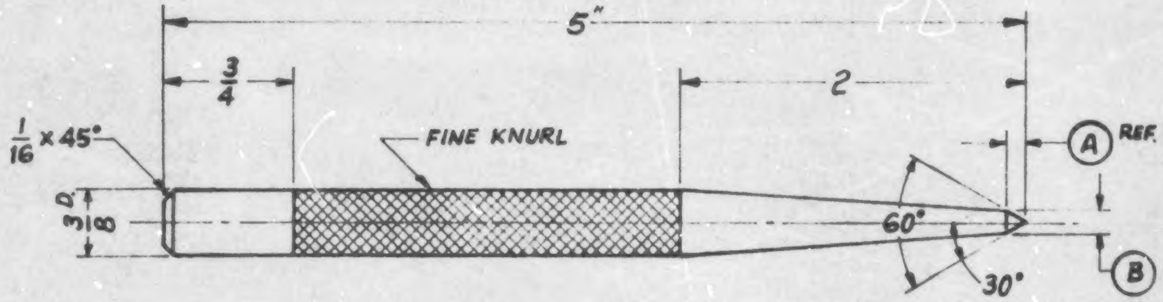
1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

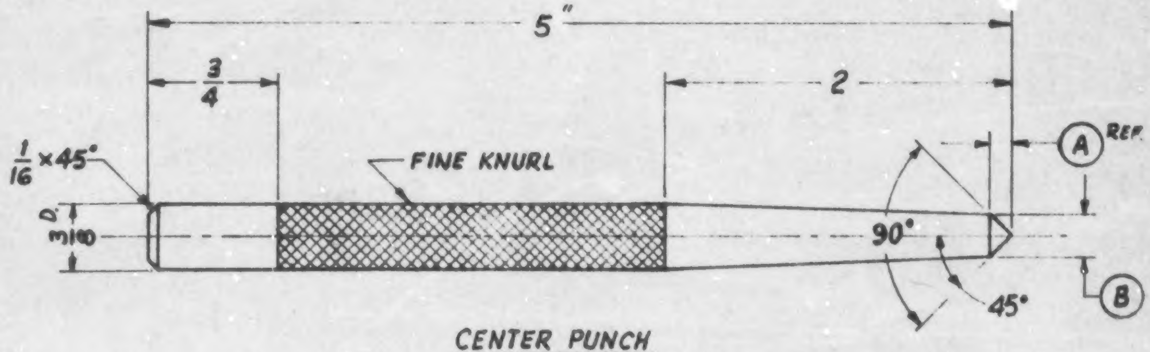
REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.

NOTE: THE TASK SHEETS FOR THIS JOB ARE DESIGNED FOR REF. #4 ON DRAWING #18. IF OTHER SIZES ARE DESIRED, DIMENSIONS ON TAPER AND POINT MUST BE CHANGED ACCORDINGLY.


5"
3/4
2
1/16 × 45°
FINE KNURL
3/8 D.
60°
30°
A REF.
B

PRICK PUNCH


5"
3/4
2
1/16 × 45°
FINE KNURL
3/8 D.
90°
45°
A REF.
B

CENTER PUNCH

HARDEN & TEMPER

REF. NO.	PRICK PUNCH		CENTER PUNCH	
	A	B	A	B
1	3/64	1/16	1/16	1/8
2	1/16	5/64	5/64	5/32
3	5/64	3/32	3/32	3/16
4	7/64	1/8	1/8	1/4

DRAWING NO. 18

LATHE JOB NO. 6

PRICK & CENTER PUNCH

MATERIAL: TOOL STEEL
FINISH: FILE & POLISH
SCALE: FULL SIZE

TOLERANCES UNLESS OTHERWISE NOTED

FRACTIONS - ± 1/64"
DECIMAL - ± .005"
ANGLES - ± 1/4°

EL-6

JOB SHEET
IN
ENGINE LATHE

JOB: MAKE CENTER PUNCH

MATERIALS: ONE PIECE 3/8" ROUND X 6" LONG TOOL STEEL

TOOLS AND EQUIPMENT: ENGINE LATHE, INDEPENDENT CHUCK, HERMAPHRODITE CALIPER, 3/8" COLLET CHUCK, LAYOUT TOOLS, LATHE CUTTING TOOLS, LIVE CENTER, FINE KNURLING TOOL, CUT-OFF TOOL, MILL FILE, ABRASIVE CLOTH, OUTSIDE CALIPERS, 6" STEEL RULE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 36-1 TO 36-44 AND REF. #2, PP. 462-493. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

EL-6-1	CHECK LATHE FOR PROPER RUNNING CONDITION, STUD, EL-1-1
EL-6-2	MOUNT WORK IN INDEPENDENT CHUCK
EL-6-3	FACE AND CENTER DRILL ONE END, STUD, EL-1-3, EL-1-4
EL-6-4	KNURL WORK PIECE
EL-6-5	CUT OFF CENTER DRILLED END
EL-6-6	MOUNT THE WORK PIECE IN 3/8" COLLET CHUCK, STUD, EL-1-2a NOTE: EXPOSE 2 1/4" OF END TO BE TAPERED
EL-6-7	CUT TAPER
EL-6-8	CUT POINT
EL-6-9	FACE END, STUD, EL-1-4
EL-6-10	CHAMFER AND POLISH END

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. PROPER MACHINE SETUP.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. TAPER CUT AT PROPER ANGLE.
4. POINT CUT AT PROPER ANGLE.
5. POLISHED SURFACES.
6. KNURL CLEAN AND EVEN.
7. CHAMFER HELD TO 1/16" X 45°.
8. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: EL-6
TASK: 2
PAGE: 1

TASK:	MOUNT WORK IN INDEPENDENT CHUCK
JOB:	MAKE CENTER PUNCH
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ENGINE LATHE, INDEPENDENT CHUCK, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT CHUCK	1. CLEAN THREADS ON HEADSTOCK SPINDLE 2. CLEAN THREADS ON CHUCK 3. SCREW CHUCK ONTO SPINDLE 4. TIGHTEN CHUCK
2. MOUNT WORK	1. PLACE WORK PIECE IN CHUCK WITH 1/2" EXPOSED 2. TIGHTEN EACH JAW WITH THE CHUCK WRENCH 3. CENTER WORK APPROXIMATELY BY USING THE CONCENTRIC RINGS ON THE CHUCK FACE AS A GUIDE
3. INDICATE WORK	1. MOUNT THE DIAL INDICATOR ON TOOL HOLDER IN TOOL POST 2. CENTER WORK BETWEEN ONE PAIR OF JAWS AT A TIME, 1 AND 3 3. CENTER BETWEEN JAWS 2 AND 4

SKETCHES: DRAWING #18: PRICK AND CENTER PUNCH

REFERENCES: REF. #1, PP. 36-8
REF. #2, P. 465

TASK SHEET

JOB: EL-6
TASK: 4
PAGE: 1

TASK:	KNURL WORK PIECE
JOB:	MAKE CENTER PUNCH
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ENGINE LATHE, 3/4" COLLET CHUCK, HERMAPHRODITE CALIPER, SCRIBER, LIVE CENTER, FINE KNURLING TOOL, OIL CAN, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LAYOUT 2 1/4" TO BE KNURLED	1. SET HERMAPHRODITE CALIPER ON 3/4" 2. SCRIBE A LAYOUT LINE AROUND WORK PIECE ON OPPOSITE END FROM CENTER POINT 3. SET CALIPER ON 3" 4. SCRIBE SECOND LINE 3" FROM SAME END 5. KNURL BETWEEN SCRIBE LINES
2. MOUNT WORK PIECE IN CHUCK	REPEAT TASK 2 NOTE: CHUCK ON 1/2" OF WORK PIECE WITH CENTER DRILLED END EXPOSED
3. SET UP CENTER	1. WIPE TAILSTOCK SPINDLE CLEAN 2. INSERT LIVE CENTER IN TAILSTOCK SPINDLE 3. SLIDE TAILSTOCK TO LEFT LEAVING 1/2" BETWEEN WORK PIECE AND CENTER 4. LOCK TAILSTOCK IN PLACE 5. ADVANCE TAILSTOCK SPINDLE UNTIL CENTER IS ENGAGED IN CENTER HOLE 6. APPLY ENOUGH PRESSURE TO ELIMINATE PLAY IN WORK PIECE 7. TIGHTEN TAILSTOCK BINDING LEVER
4. SET MACHINE FEED AND SPEED	1. SET MACHINE IN BACK GEAR 2. SET RPM AT 100 3. SET FEED AT FROM .020" TO .035" PER REVOLUTION

4.	SET MACHINE FEED AND SPEED (CON'T.)	4.	SET CARRIAGE FEED DIRECTION TO FEED TOWARD HEADSTOCK
5.	POSITION KNURLING TOOL	1. 2. 3. 4. 5.	SELECT FINE KNURLING TOOL NOTE: BE SURE KNURLS ARE CLEAN AND ROTATE FREELY MOUNT KNURLING TOOL IN TOOL POST TURN TABLE LONGITUDINAL HANDLE AND CROSS SLIDE HANDWHEEL TO POSITION TOOL 1/8" FROM WORK PIECE MOVE THE KNURLING TOOL TO BEAR EVENLY AGAINST WORK PIECE WITH WHEEL FACES PARALLEL WITH WORK FACE USE TOOL POST WRENCH TO TIGHTEN KNURLING TOOL IN TOOL POST
6.	KNURL WORK PIECE	1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12.	PUT ON SAFETY GOGGLES START MACHINE MOVE TABLE LONGITUDINAL UNTIL RIGHT SIDE OF KNURLING WHEEL IS ON RIGHT LAYOUT LINE HAND FEED CROSS SLIDE IN UNTIL THE KNURLS BEGIN TO FORM A DISTINCT PATTERN OIL ENTIRE AREA TO BE KNURLED ENGAGE LONGITUDINAL FEED LEVER REVERSE LONGITUDINAL FEED LEVER WHEN KNURLING WHEELS REACH LAYOUT LINE ON LEFT END OF THE WORK PIECE NOTE: THE MACHINE IS NOT TO BE STOPPED APPLY MORE PRESSURE ON THE WORK PIECE BY FEEDING CROSS SLIDE IN REPEAT UNTIL DESIRED KNURL IS OBTAINED BACK TOOL AWAY FROM WORK WITH CROSS SLIDE HANDWHEEL WHILE WORK IS STILL TURNING STOP MACHINE REMOVE KNURLING TOOL, CLEAN, AND STORE

SKETCHES: DRAWING #18: PRICK AND CENTER PUNCH

REFERENCES: REF. #1, P. 36-37
REF. #2, PP. 486-487

TASK SHEET

JOB: EL-6
TASK: 5
PAGE: 1

TASK: CUT CENTER DRILLED END OFF

JOB: MAKE CENTER PUNCH

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, INDEPENDENT CHUCK, 6" STEEL RULE, HAND HACKSAW, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LAYOUT LENGTH	1. LEAVE WORK PIECE IN CHUCK
	2. SLIDE TAILSTOCK OUT OF THE WAY TO RIGHT
	3. USE RULE MEASURE 5 1/8" FROM THE CHUCKED END OF WORK PIECE
	4. LAYOUT LINE WITH A PENCIL
2. SAW WORK PIECE	1. SELECT THE HAND HACKSAW WITH 18 TOOTH BLADE
	2. SAW END OFF AT LAYOUT LINE
	3. TAKE WORK PIECE OUT OF CHUCK
	4. RETURN HACKSAW TO PROPER PLACE
	5. REMOVE AND STORE THE INDEPENDENT CHUCK

SKETCHES: DRAWING #18: PRICK AND CENTER PUNCH

REFERENCES: REF. #1, PP. 9-1 TO 9-5
REF. #2, PP. 84-89

TASK SHEET

JOB: EL-6
TASK: 7
PAGE: 1

TASK: CUT TAPER

JOB: MAKE CENTER PUNCH

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, TURNING TOOL, MICROMETER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET MACHINE FEED AND SPEED	1. SET FEED TO REMOVE .004" PER REVOLUTION
	2. SET SPEED AT 300 RPM
2. SET UP COMPOUND REST	NOTE: TAPER CAN BE CUT BY THREE DIFFERENT METHODS: a. TAPER ATTACHMENT b. COMPOUND REST c. TAILSTOCK THE FOLLOWING INSTRUCTIONS FOR THIS TASK USE THE COMPOUND REST METHOD
	1. LOOSEN LOCKING NUTS ON EACH SIDE OF COMPOUND REST
	2. USE DEGREE INDICATOR AT THE BASE OF COMPOUND REST TO SET COMPOUND REST ON 1° 47' NOTE: IT WILL BE NECESSARY TO SET 1 3/4 DEGREES AS THERE IS NO MINUTE INDICATOR
	3. TIGHTEN LOCKING NUTS SECURE COMPOUND REST IN POSITION
	4. SET MAXIMUM AMOUNT OF TRAVEL BY TURNING COMPOUND REST COUNTERCLOCKWISE AS FAR AS POSSIBLE
3. POSITION TOOL	1. POSITION TURNING TOOL FOR TURNING DIAMETER
	2. TIGHTEN TOOL HOLDER IN TOOL POST
	3. TURN LONGITUDINAL AND CROSS SLIDE HANDWHEELS UNTIL TOOL POINT IS NEAR END OF WORK

4. TURN TAPER

1. PUT SAFETY GOGGLES ON
2. START MACHINE
3. MOVE CROSS SLIDE IN .020"
4. TURN COMPOUND REST HANDWHEEL CLOCKWISE SLOWLY UNTIL TOOL COMPLETES THE CUT
5. RETURN TOOL TO STARTING POINT OFF END OF WORK PIECE BY TURNING THE HANDWHEEL COUNTERCLOCKWISE
6. FEED TOOL IN .020"
7. TAKE SECOND CUT
8. CONTINUE CUTTING UNTIL ANGLE OF CUT REACHES KNURL 2" FROM END
9. HOLD 1/4" DIAMETER 1/8" FROM POINT OF WORK PIECE
10. TURN MACHINE OFF

SKETCHES: DRAWING #18: PRICK AND CENTER PUNCH

REFERENCES: REF. #1, P. 36-25

TASK SHEET

JOB: EL-6
TASK: 8
PAGE: 1

TASK: CUT POINT

JOB: MAKE CENTER PUNCH

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, TURNING TOOL, MICROMETER, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP COMPOUND REST	1. LOOSEN LOCKING NUTS
	2. SET COMPOUND REST ON 45 DEGREES WITH HANDWHEEL END TOWARD HEADSTOCK NOTE: THIS IS 1/2 THE INCLUDED ANGLE OF 90 DEGREES GIVEN ON DRAWING
	3. TIGHTEN LOCKING NUTS ON COMPOUND REST
2. SET UP CUTTING TOOL	1. SET TOOL POST ON EXTREME LEFT EDGE OF COMPOUND REST
	2. ADJUST TURNING TOOL TO CORRECT POSITION FOR TURNING POINT AND ON CENTER LINE OF WORK PIECE
	3. LOOSEN CARRIAGE LOCK
	4. TURN LONGITUDINAL AND CROSS SLIDE HANDWHEELS TO POSITION POINT OF TOOL NEAR END OF WORK PIECE
	5. ALL CUTTING WILL BE DONE FROM LEFT TO RIGHT CAUTION: THE CARRIAGE HANDWHEEL IS VERY NEAR THE CHUCK AND CARE MUST BE TAKEN TO PREVENT INJURY
3. CUT POINT	1. PUT SAFETY GOGGLES ON
	2. TURN MACHINE ON
	3. CUT POINT SAME AS TAPER ANGLE
	4. CONTINUE TO CUT UNTIL POINT IS OBTAINED
4. POLISH	1. LEAVE MACHINE RUNNING
	2. HOLD ABRASIVE CLOTH AGAINST EACH

4. POLISH (CON'T.)

ANGLE TO POLISH
NOTE: KEEP HANDS CLEAR OF CHUCK
3. REMOVE ALL TOOL MARKS
4. STOP MACHINE
5. REMOVE WORK PIECE

SKETCHES: DRAWING #18: PRICK AND CENTER PUNCH

REFERENCES: REF. #1, PP. 36-20 AND 36-25

TASK SHEET

JOB: EL-6
TASK: 10
PAGE: 1

TASK: CHAMFER AND POLISH END

JOB: MAKE CENTER PUNCH

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, 3/8" COLLET CHUCK, MILL FILE, MICROMETER, 6" STEEL RULE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CHAMFER END	1. SELECT SHARP FILE WITH HANDLE 2. LEAVE MACHINE RUNNING 3. PLACE FILE ON END OF WORK PIECE AT 45 DEGREE ANGLE 4. HAND FILE 1/16" X 45° CHAMFER ON END 5. TURN MACHINE OFF 6. REMOVE WORK PIECE 7. RETURN FILE TO PROPER PLACE
2. POLISH TO KNURL	REPEAT POLISH PROCEDURE AS DONE ON TAPER AND POINT
3. CLEAN MACHINE	1. REMOVE COLLET CHUCK, CLEAN, AND STORE 2. BRUSH AND WIPE MACHINE
4. INSPECT WORK PIECE	1. 5" LENGTH 2. 3/4" LENGTH 3. 2" LENGTH 4. 2 1.4" LENGTH 5. 1/4" DIAMETER 6. 1/16" X 45° CHAMFER 7. KNURL

ROUTE TO HEAT TREAT

SKETCHES: DRAWING #18: PRICK AND CENTER PUNCH

REFERENCES: REF. #1, P. 36-37

HEAT TREAT AS IN PRECEEDING JOBS

MACHINE SHOP HAND AND MACHINE PUNCHES

ENGINE LATHE 7

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND CONSTRUCT HAND AND MACHINE PUNCHES ACCORDING TO SPECIFICATIONS.

CHECKING STANDARDS

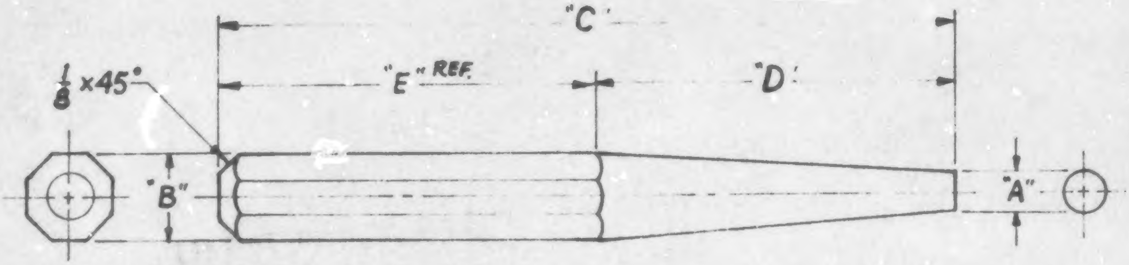
1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

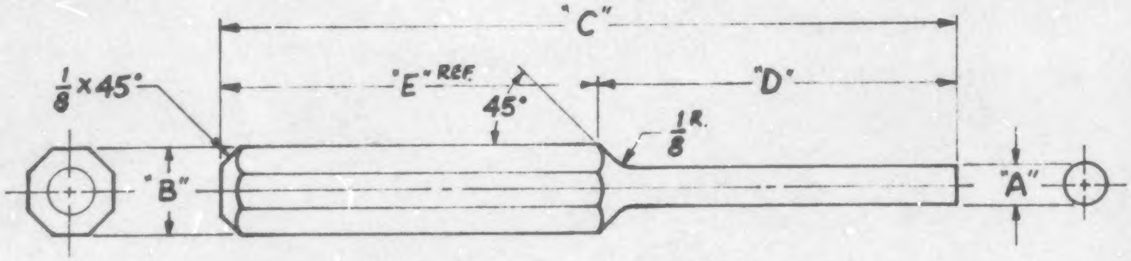
REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.

NOTE: THE TASK SHEETS FOR THIS JOB ARE FOR REF. #4, DRAWING #19. IF OTHER SIZES ARE DESIRED, DIMENSIONS MUST BE CHANGED ACCORDINGLY.



HAND PUNCH



MACHINE PUNCH

HARDEN & TEMPER

REF. NO.	TIP	STOCK	OTHER DIMENSIONS		
	A	B	C	D	E
1	3/32	3/8	5½	2	3½
2	1/8	3/8	6¼	2½	3¾
3	3/16	1/2	7	3	4
4	1/4	5/8	7½	3¼	4¼
5	5/16	3/4	8¼	3½	4¾

DRAWING NO. 19	PUNCH	TOLERANCES UNLESS OTHERWISE NOTED
LATHE JOB NO. 7	MATERIAL: OCTAGON TOOL STEEL FINISH: FILE & POLISH SCALE: NONE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4°

JOB SHEET
IN
ENGINE LATHE

EL-7

JOB: MAKE HAND AND MACHINE PUNCHES

MATERIALS: ONE PIECE 5/8" OCTAGONAL TOOL STEEL 7 5/8" LONG

TOOLS AND EQUIPMENT: ENGINE LATHE, OCTAGONAL COLLET OR INDEPENDENT CHUCK, LATHE CUTTING TOOL, LAYOUT TOOLS, HERMAPHRODITE CALIPER, RADIUS GAUGE, CUT-OFF TOOL, MILL FILE, ABRASIVE CLOTH

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 36-1 TO 36-44 AND REF. #2, PP. 462-493. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

EL-7-1	CHECK LATHE FOR PROPER RUNNING CONDITION, STUD, EL-1-1
EL-7-2	MOUNT WORK PIECE IN 5/8" OCTAGONAL COLLET CHUCK, STUD, EL-1-2a NOTE: IF OCTAGONAL COLLET IS NOT AVAILABLE, MOUNT WORK IN AN INDEPENDENT CHUCK, CENTER PUNCH, EL-6-1
EL-7-3	FACE END OF STOCK, STUD, EL-1-4
EL-7-4	LAYOUT 3 1/4" FROM FACE END WITH HERMAPHRODITE CALIPER, CENTER PUNCH, EL-6-4
EL-7-5	MOUNT WORK PIECE WITH 3 1/2" EXPOSED, TASK 2
EL-7-6	CUT TAPER, CENTER PUNCH, EL-6-7 NOTE: SET COMPOUND REST ON 3° 15'
EL-7-6b	OPTIONAL TASK FOR MACHINE PUNCH
EL-7-7	POLISH TAPER, CENTER PUNCH, EL-6-8
EL-7-8	FACE HEAD END, STUD, EL-1-4 NOTE: HOLD LENGTH TO 7 1/2"
EL-7-9	CHAMFER AND POLISH END, STUD, EL-1-5 NOTE: HOLD 1/8"
EL-7-10	ROUTE TO THE HEAT TREAT, PARALLEL BLOCKS, HT-1

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. PROPER MACHINE SETUP.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. TAPER CUT TO PROPER ANGLE ON HAND PUNCH.
4. ANGLE AND DIAMETER HELD ON MACHINE PUNCH.

5. SURFACE POLISHED.
6. CHAMFER 1/8" X 45°.
7. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

OPTIONAL JOB: EL-7
TASK: 6b
PAGE: 1

TASK: TURN DIAMETER

JOB: MAKE HAND AND MACHINE PUNCHES

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, 1/8" R. TURNING TOOL, HERMAPHRODITE CALIPER, LAYOUT TOOLS, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LAYOUT	REPEAT TASK 4 NOTE: LAYOUT AN ADDITIONAL LINE AT 3 1/16" FROM END
2. SET UP TOOL	1. SELECT SHARP TURNING TOOL WITH 1/8" RADIUS ON NOSE
	2. MOUNT TOOL IN TOOL HOLDER
	3. MOUNT TOOL HOLDER IN TOOL POST
	4. SWING TOOL HOLDER AROUND UNTIL TOOL IS PERPENDICULAR TO WORK PIECE
	5. TIGHTEN TOOL IN TOOL POST
3. SET MACHINE FEED AND SPEED	1. SET FEED AT .007" CUT PER REVOLUTION
	2. SET SPEED AT 200 RPM
4. TURN DIAMETER	1. MOVE CARRIAGE AND CROSS SLIDE TO POSITION TOOL AT RIGHT END OF WORK
	2. PUT SAFETY GOGGLES ON
	3. START MACHINE
	4. MOVE CROSS SLIDE IN UNTIL THE TOOL TOUCHES WORK PIECE
	5. MOVE CARRIAGE TO RIGHT UNTIL TOOL IS OFF WORK PIECE
	6. FEED CROSS SLIDE IN .080" BY THE DIAL
	7. ENGAGE LONGITUDINAL FEED LEVER
	8. DISENGAGE FEED LEVER WHEN CUTTING TOOL REACHES LAYOUT LINE
	9. TURN DIAMETER TO 1/4"
	10. STOP MACHINE

5. TURN ANGLE

1. SET COMPOUND REST ON 45 DEGREE ANGLE WITH HANDWHEEL TOWARD THE HEADSTOCK
2. ADJUST CARRIAGE AND TOOL TO CUT ANGLE
3. START MACHINE
4. TURN ANGLE UNTIL CUT BLENDS WITH 1/8" RADIUS AND LAYOUT LINE
5. POLISH WITH ABRASIVE CLOTH
6. STOP MACHINE
7. REMOVE WORK PIECE

SKETCHES: DRAWING #19: HAND AND MACHINE PUNCHES

REFERENCES: REF. #1, PP. 36-16 TO 36-20
REF. #2, PP. 479-483

MACHINE SHOP NAIL SET

ENGINE LATHE 8a (ROUND HEAD)

ENGINE LATHE 8b (SQUARE HEAD)

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND CONSTRUCT A NAIL SET ACCORDING TO SPECIFICATIONS; USING TOOLS, MACHINES, EQUIPMENT, AND MATERIALS CALLED FOR IN THE JOB.

CHECKING STANDARDS

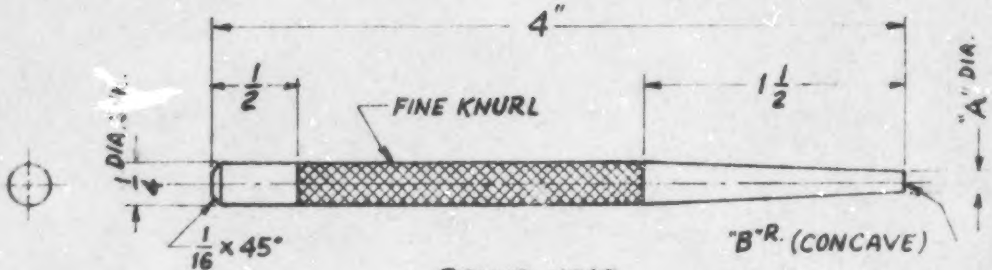
1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

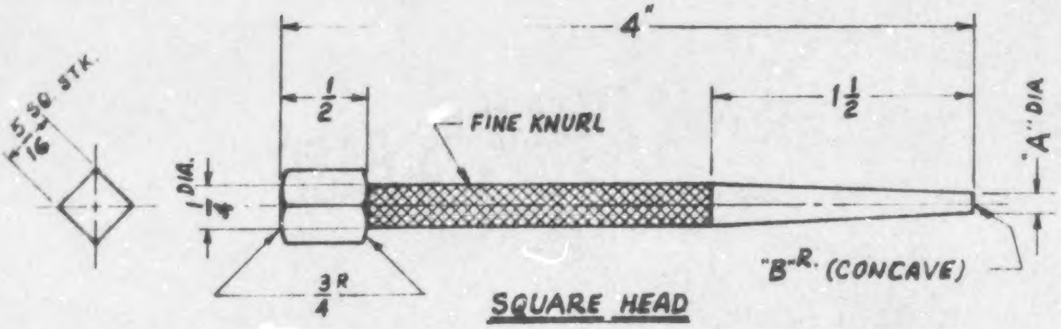
REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.

NOTE: THE TASK SHEETS FOR THIS JOB ARE DESIGNED FOR REF. #5, DRAWING #20. IF OTHER SIZES ARE DESIRED, DIMENSIONS MUST BE CHANGED ACCORDINGLY.


4"
1/2
1 1/2
FINE KNURL
1/4 DIA. STK.
"A" DIA.
1/16 × 45°
"B" R. (CONCAVE)

ROUND HEAD


4"
1/2
1 1/2
FINE KNURL
5/16 SQ. STK.
1/4 DIA.
"A" DIA
3/4 R
"B" R. (CONCAVE)

SQUARE HEAD

*HARDEN & TEMPER

REF. NO.	"A" DIA.	"B" RAD.	APPROX. ∠ W/ ℄
1	.031	1/32	4°15'
2	.062	1/16	3°-30'
3	.078	5/64	3°15'
4	.094	3/32	3°
5	.125	1/8	2°30'
6	.156	5/32	1°45'

DRAWING NO. 20

NAIL SET

TOLERANCES UNLESS OTHERWISE NOTED

LATHE JOB NO. 8

MATERIAL: TOOL STEEL
FINISH: POLISH
SCALE: FULL SIZE

FRACTIONS - ± 1/64"
DECIMAL - ± .005"
ANGLES - ± 1/4°

EL-8a

JOB SHEET
IN
ENGINE LATHE

JOB: MAKE ROUND HEAD NAIL SET

MATERIALS: ONE PIECE 1/4" ROUND X 4 1/8" LENGTH TOOL STEEL

TOOLS AND EQUIPMENT: ENGINE LATHE, 1/4" COLLET CHUCK, OUTSIDE CALIPER, LAYOUT TOOLS, LATHE CUTTING TOOLS, FINE KNURLING TOOL, CUTTING OFF TOOL, MILL FILE, ABRASIVE CLOTH, TOOL BIT GROUND TO CUP POINT

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1 PP. 36-1 TO 36-44 AND REF. #2, PP. 462-493. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

EL-8a-1	CHECK LATHE FOR PROPER RUNNING CONDITION, STUD, EL-1-1
EL-8a-2	MOUNT 1/4" COLLET CHUCK, STUD, EL-1-2a
EL-8a-3	CUT CONCAVE RADIUS
EL-8a-4	CUT TAPER
EL-8a-5	KNURL
EL-8a-6	FACE AND CHAMFER HEAD - HOLD TO 4" LENGTH WITH 1/16" CHAMFER, PRICK AND CENTER PUNCH, EL-6
EL-8a-7	HEAT TREAT, PARALLEL BLOCKS, HT-1

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. PROPER MACHINE SETUP.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. KNURL CLEAN AND WITHIN LIMITS OF SPECIFICATIONS.
4. CHAMFER AND CONCAVE RADIUS PROPERLY MACHINED.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: EL-8a
TASK: 3
PAGE: 1

TASK:	CUT CONCAVE RADIUS
JOB:	MAKE ROUND HEAD NAIL SET
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ENGINE LATHE, TURNING TOOL GROUND TO 1/8" RADIUS, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. FACE END	SEE: (STUD, EL-1-4)
2. INSTALL TOOL	1. SELECT 1/8" RADIUS TURNING TOOL 2. PLACE THE TOOL IN RIGHT HAND TOOL HOLDER 3. RADIUS END EXTENDED 1/2" 4. PLACE TOOL HOLDER IN TOOL POST
3. POSITION TOOL	1. TOOL POINT TOWARD BACK AND HEAD-STOCK 2. TOOL SETTING ON 45 DEGREE ANGLE TO WORK 3. NOSE OF TOOL ON CENTER LINE OF WORK PIECE 4. TIGHTEN TOOL POST 5. USE TABLE LONGITUDINAL AND CROSS SLIDE HANDWHEELS TO POSITION TOOL IN CENTER AND AT END OF THE WORK PIECE
4. MACHINE RADIUS	1. PUT ON SAFETY GOGGLES 2. START MACHINE IN FORWARD MOTION 3. HAND FEED TOOL INTO THE WORK, USE CARRIAGE HANDWHEEL 4. CUT TO 1/8" WIDTH CONCAVE RADIUS 5. STOP MACHINE 6. LOOSEN HOLDING DEVICE 7. REMOVE WORK PIECE

SKETCHES: DRAWING #20: NAIL SET

REFERENCES: REF. #1, P. 36-22
REF. #2, P. 478

TASK SHEET

JOB: EL-8a
TASK: 4
PAGE: 1

TASK: CUT TAPER

JOB: MAKE ROUND HEAD NAIL SET

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, 1/4" COLLET CHUCK, HERMAPHRODITE CALIPER, SCRIBER, CUTTING TOOL, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. MOUNT WORK PIECE	1. PLACE WORK PIECE IN CHUCK WITH CONCAVE END OUT 2. ALLOW 1 3/4" TO PROTRUDE FROM FACE OF CHUCK NOTE: THERE IS NO CENTER DRILLED HOLE AND CENTER WILL NOT BE USED
2. TRUE WORK PIECE	1. MOUNT THE DIAL INDICATOR ON TOOL HOLDER IN TOOL POST 2. PLACE INDICATOR PLUNGER LIGHTLY AGAINST WORK PIECE 3. TURN DIAL FACE UNTIL THE "O" LINE COINCIDES WITH THE INDICATOR HAND 4. TURN WORK PIECE SLOWLY BY HAND 5. ADJUST WORK PIECE UNTIL THERE IS LITTLE OR NO MOVEMENT OF INDICATOR HAND
3. LAYOUT FOR TAPER CUT	1. SET THE HERMAPHRODITE CALIPER ON 1 1/2" 2. SCRIBE THE LINE AROUND WORK PIECE 1 1/2" FROM CONCAVE END
4. MAKE TAPER CUT	1. LOOSEN LOCKING NUTS ON EACH SIDE OF COMPOUND REST 2. SET COMPOUND REST ON $2^{\circ}\ 30'$ USING DEGREE INDICATOR AT THE BASE OF COMPOUND REST NOTE: IT WILL BE NECESSARY TO SET AT $2\ 1/2^{\circ}$ AS THERE IS NO MINUTE INDICATOR NOTE: THE COMPOUND REST SHOULD

4. MAKE TAPER CUT (CON'T.)	BE SLIGHTLY OFF PARALLEL FROM WAYS WITH HANDWHEEL END CLOSER TO BACK OF MACHINE
	3. TIGHTEN LOCKING NUTS
	4. TURN COMPOUND REST HANDWHEEL COUNTERCLOCKWISE AS FAR AS POSSIBLE TO SET MAXIMUM AMOUNT OF TRAVEL
	5. TAKE SMALL CUTS UNTIL ANGLE IS TURNED TO LAYOUT LINE
5. POLISH	1. LEAVE MACHINE RUNNING
	2. USE ABRASIVE CLOTH NOTE: KEEP HANDS CLEAR OF ROTATING CHUCK
	3. TURN MACHINE OFF
	4. REMOVE WORK PIECE

SKETCHES: DRAWING #20: NAIL SET

REFERENCES: REF. #1, P. 36-20 AND P. 36-25

TASK SHEET

JOB: EL-8a
TASK: 5
PAGE: 1

TASK: KNURL NAIL SET

JOB: MAKE ROUND HEAD NAIL SET

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, 1/4" COLLET CHUCK, HERMAPHRODITE CALIPER, SCRIBER, CUTTING TOOL, FINE KNURLING TOOL, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WORK PIECE	1. INSERT WORK PIECE IN 1/4" COLLET 2. CHUCK ON 1/4" TO 3/8" OF WORK PIECE 3. USE DIAL INDICATOR TO TRUE WORK 4. USE BELL CUP IN TAILSTOCK FOR ADDITIONAL SUPPORT NOTE: WORK PIECE WILL BEND IF TOO MUCH PRESSURE IS APPLIED WHEN KNURLING
2. LAYOUT FOR KNURL	1. SET THE HERMAPHRODITE CALIPER ON 3 1/2" 2. SCRIBE LINE AROUND WORK PIECE 3 1/2" FROM CONCAVE RADIUS AND 2" FROM FIRST LAYOUT LINE
3. SET MACHINE FEED AND SPEED	1. SET MACHINE IN BACKGEAR 2. SET RPM AT 100 3. SET FEED AT FROM .020" TO .035" PER REVOLUTION 4. SET THE CARRIAGE FEED DIRECTION TOWARD HEADSTOCK
4. POSITION KNURLING TOOL	1. SELECT FINE KNURLING TOOL NOTE: BE SURE KNURLS ARE CLEAN AND ROTATE FREELY 2. MOUNT KNURLING TOOL IN TOOL POST 3. TURN TABLE LONGITUDINAL HANDLE AND CROSS SLIDE HANDWHEEL TO POSITION TOOL 1/8" FROM WORK PIECE 4. MOVE THE KNURLING TOOL TO BEAR EVENLY AGAINST WORK PIECE WITH

4. POSITION KNURLING TOOL (CON'T.)		WHEEL FACES PARALLEL WITH WORK FACE
	5.	USE TOOL POST WRENCH TO TIGHTEN KNURLING TOOL IN TOOL POST
5. KNURL WORK PIECE	1.	PUT ON SAFETY GOGGLES
	2.	START MACHINE
	3.	MOVE TABLE LONGITUDINAL UNTIL RIGHT SIDE OF KNURLING WHEEL IS ON RIGHT LAYOUT LINE
	4.	HAND FEED CROSS SLIDE IN UNTIL THE KNURLS BEGIN TO FORM A DISTINCT PATTERN
	5.	OIL ENTIRE AREA TO BE KNURLED
	6.	ENGAGE LONGITUDINAL FEED LEVER
	7.	REVERSE LONGITUDINAL FEED LEVER WHEN KNURLING WHEELS REACH LAYOUT LINE ON LEFT END OF THE WORK PIECE NOTE: THE MACHINE SHOULD NOT BE STOPPED
	8.	APPLY MORE PRESSURE ON THE WORK PIECE BY FEEDING CROSS SLIDE
	9.	REPEAT UNTIL DESIRED KNURL IS OBTAINED
	10.	BACK TOOL AWAY FROM WORK WITH CROSS SLIDE HANDWHEEL WHILE WORK IS STILL TURNING
	11.	STOP MACHINE
	12.	REMOVE KNURLING TOOL, CLEAN, AND STORE
	13.	REMOVE WORK PIECE
6. INSPECT	1.	DIAMETER "C" OF 1/8 ± .005"
	2.	LENGTH OF TAPER 1 1/2"
	3.	LENGTH OF KNURL 2"
	4.	LENGTH OF HEAD 1/2"
	5.	CHAMFER 1/16" X 45°

SKETCHES: DRAWING #20: NAIL SET

REFERENCES: REF. #1, P. 36-37
REF. #2, PP. 486-487

EL-8b

JOB SHEET
IN
ENGINE LATHE

JOB: MAKE SQUARE HEAD NAIL SET

MATERIALS: TWO PIECES 5/16" X 4 1/8" SQUARE TOOL STEEL

TOOLS AND EQUIPMENT: ENGINE LATHE, INDEPENDENT CHUCK, OUTSIDE CALIPER, LAYOUT TOOLS, CUTTING TOOLS, FINE KNURLING TOOL, CUTTING OFF TOOL, MILL FILE, ABRASIVE CLOTH, TOOL BIT GROUND TO CUP POINT

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 36-1 TO 36-44 AND REF. #2, PP. 462-493. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

EL-8b-1	CHECK LATHE FOR PROPER RUNNING CONDITIONS
EL-8b-2	MOUNT INDEPENDENT CHUCK, STUD, EL-1-2b
EL-8b-3	CUT CONCAVE RADIUS, EL-8a-3
EL-8b-4	CUT TAPER, EL-8a-4 NOTE: THE LEFT END OF TAPER CUT WILL EXCEED 1 1/2", HOWEVER WHEN 1/4" DIAMETER IS CUT IN STEP 5, THE 1 1/2" LENGTH WILL BE MAINTAINED
EL-8b-5	TURN DIAMETER
EL-8b-6	KNURL, EL-8a-5
EL-8b-7	FACE END, EL-8a-6 NOTE: MOUNT THE WORK IN 1/4" COLLET CHUCK AND HOLD TO 4" LENGTH
EL-8b-8	FILE TWO 3/4" RADII ON HEAD

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. PROPER MACHINE SETUP.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. TAPER CUT AT PROPER ANGLE AND POLISHED.
4. CONCAVE RADIUS PROPERLY MACHINED.
5. PROPER RADII ON HEAD.
6. KNURL CLEAN AND EVEN.
7. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: EL-8b
TASK: 5
PAGE: 1

TASK: TURN DIAMETER

JOB: MAKE SQUARE HEAD NAIL SET

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, 1/64" R. TURNING TOOL, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. INSTALL TOOL	1. SELECT 1/64" RADIUS TURNING TOOL 2. MOUNT TOOL IN TOOL HOLDER 3. SWING TOOL HOLDER IN TOOL POST UNTIL TOOL IS PERPENDICULAR TO WORK 4. TIGHTEN TOOL HOLDER NOTE: THE TOOL POST SHOULD BE MOUNTED ON LEFT SIDE OF THE COMPOUND REST
2. SET MACHINE	1. MOVE CARRIAGE AND CROSS SLIDE TO POSITION TOOL NEAR RIGHT END OF WORK PIECE 2. PLACE TOOL 1/16" FROM WORK 3. SET AT 200 RPM 4. SET FEED AT .007" PER REVOLUTION
3. TURN TO 1/4" DIAMETER	1. PUT SAFETY GOGGLES ON 2. START MACHINE 3. MOVE TOOL TO RIGHT UNTIL OFF THAT PORTION TO BE TURNED 4. FEED CROSS SLIDE IN .080" BY THE DIAL 5. ENGAGE LONGITUDINAL FEED LEVER 6. DISENGAGE THE FEED LEVER AT 3 1/2" MARK 7. RETURN CARRIAGE TO STARTING POINT 8. MAKE SECOND CUT TO SHOULDER OF FIRST CUT 9. REPEAT UNTIL 1/4" DIAMETER IS OBTAINED

3. TURN TO 1/4" DIAMETER (CON'T.)

10. STOP MACHINE

SKETCHES: DRAWING #20: NAIL SET

REFERENCES: REF. #1, PP. 36-1 TO 36-44
REF. #2, PP. 462-493

TASK SHEET

JOB: EL-8b
TASK: 8
PAGE: 1

TASK:	FILE 3/4" RADII
JOB:	MAKE SQUARE HEAD NAIL SET
TRADE:	MACHINIST
TOOLS AND MATERIALS:	ENGINE LATHE, MILL FILE, MICROMETER, COMBINATION SQUARE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. FILE SQUARE END	1. TURN MACHINE ON FORWARD 2. HOLD FILE FLAT ON END OF WORK PIECE NOTE: LENGTH HAS BEEN HELD, ADDITIONAL METAL SHOULD NOT BE REMOVED FROM CENTER OF WORK PIECE 3. ANGLE FILE SLIGHTLY TOWARD SQUARE END 4. FILE OUTSIDE CORNERS AND EDGES OF SQUARE TO OBTAIN AN OVAL TOWARD CENTER OF WORK PIECE NOTE: ONLY 1/64" METAL IS REMOVED AT CORNERS TO HOLD 3/4" RADIUS
2. FILE SHOULDER	1. FILE IN SIMILAR MANNER AS STEP 1 2. CAUTION SHOULD BE TAKEN TO PREVENT EDGE OF FILE FROM DAMAGING KNURLS
3. INSPECT	1. 1/8" ± .005" "C" DIAMETER 2. 4" OVERALL LENGTH 3. 1 1/2" TAPER LENGTH 4. 2" KNURL LENGTH 5. 1/2" HEAD LENGTH 6. 1/4" DIAMETER 7. 3/4" HEAD RADIUS

ROUTE TO HEAT TREAT

SKETCHES: DRAWING #20: NAIL SET

REFERENCES: REF. #1, P. 36-37

MACHINE SHOP T-HEAD BOLTS

ENGINE LATHE 9

MILLING 9/HM-8

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND CONSTRUCT TWO T-HEAD BOLTS ACCORDING TO SPECIFICATIONS; USING TOOLS, MACHINES, EQUIPMENT, AND MATERIAL AS CALLED FOR IN THE JOB.

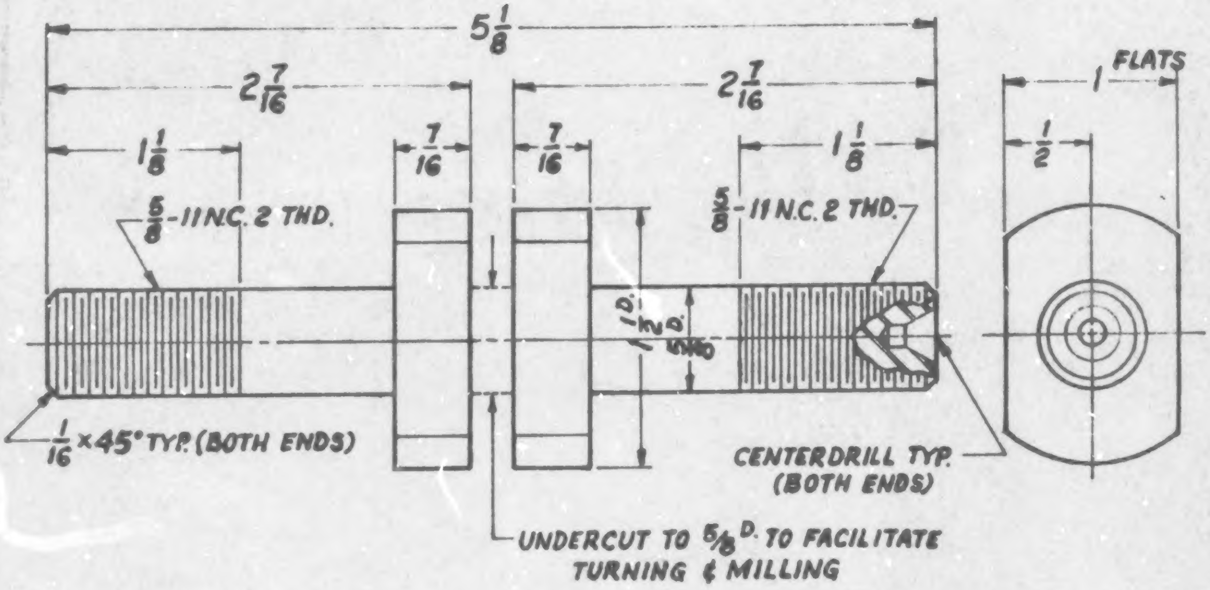
CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.


5 1/8
2 7/16
2 7/16
1 FLATS
1 1/8
7/16
7/16
1 1/8
1/2
5/8-11 N.C. 2 THD.
5/8-11 N.C. 2 THD.
1 D.
5/8 D.
1/16 × 45° TYP. (BOTH ENDS)
CENTERDRILL TYP. (BOTH ENDS)
UNDERCUT TO 5/8 D. TO FACILITATE TURNING ¢ MILLING

DRAWING NO. 21	T-HEAD BOLTS	TOLERANCES UNLESS OTHERWISE NOTED
LATHE JOB NO. 9 MILLING JOB NO. 9	MATERIAL: C.R. STEEL FINISH: TOOL ¢ FILE SCALE: FULL SIZE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4°

376

EL-9a

JOB SHEET
IN
ENGINE LATHE

JOB: MAKE TWO T-HEAD BOLTS

MATERIALS: ONE PIECE 1 1/2" ROUND X 5 1/8" LENGTH COLD ROLLED STEEL

TOOLS AND EQUIPMENT: ENGINE LATHE, FACE PLATE, TOOL HOLDER, LATHE DOG, 1" MICROMETER, ONE LINE CENTER, TOOL BIT, THREADING TOOL, CUT-OFF OR PARTING TOOL, 5/8"-11 N. C. THREAD GAUGE, OIL CAN AND CUTTING OIL, ONE DEAD CENTER, CENTER GAUGE, 6" STEEL RULE

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 36-1 TO 36-44 AND REF. #2, PP. 462-493. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

EL-9a-1	CHECK LATHE FOR PROPER RUNNING CONDITION, STUD, EL-1-1
EL-9a-2	FACE AND CENTER DRILL BOTH ENDS OF STOCK, TEST BAR, EL-2-3, EL-2-4
EL-9a-3	SET UP LATHE TO WORK BETWEEN CENTERS, TEST BAR, EL-2-6
EL-9a-4	TURN WORK PIECE, TEST BAR, EL-2-7 NOTE: HOLD 5/8" DIAMETER X 2" LENGTH ON ONE END
EL-9a-5	REVERSE WORK PIECE BETWEEN CENTERS AND TURN OPPOSITE END TO SIZE, (TASK 4) NOTE: PROTECT WORK PIECE BY USE OF A PIECE OF SOFT METAL UNDER DOG SET SCREW
EL-9a-6	SET UP LATHE TO CUT THREADS
EL-9a-7	CUT THREADS ON ONE END OF WORK PIECE
EL-9a-8	CHAMFER END OF WORK PIECE, STUD, EL-1-5
EL-9a-9	THREAD AND CHAMFER OPPOSITE END OF WORK PIECE, (TASKS 7 AND 8)
EL-9a-10	UNDERCUT WITH CUT-OFF OR PARTING TOOL

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. OIL RESERVOIRS FILLED TO PROPER LEVEL.
2. PROPER MACHINE SETUP.
3. ALL DIMENSIONS HELD TO SPECIFICATIONS.

4. 5/8" N. C. NUT FITS THREADS PROPERLY.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: EL-9a
TASK: 6
PAGE: 1

TASK: SET UP LATHE TO CUT THREADS

JOB: MAKE TWO T-HEAD BOLTS

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, THREADING TOOL, CENTER GAUGE, 6" STEEL RULE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP HEADSTOCK	1. SET QUICK CHANGE GEAR BOX TO CUT ELEVEN THREADS PER INCH
	2. ENGAGE HEADSTOCK TO BACKGEAR POSITION NOTE: RPM MAY BE INCREASED WITH EXPERIENCE
2. SET UP CARRIAGE	1. SET COMPOUND REST AT 29 DEGREE ANGLE TO THE RIGHT
	2. SET THE FEED CHANGE LEVER TO THE THREADING POSITION
	3. ENGAGE THREAD, DIAL, AND TIGHTEN LOCKING SCREW
3. SET UP TOOL	1. MOUNT THREAD TOOL IN TOOL HOLDER
	2. MOUNT TOOL HOLDER IN TOOL POST
	3. ADJUST TOOL HOLDER UNTIL POINT OF TOOL IS ON CENTER LINE OF WORK PIECE, AND SQUARE TO THE WORK NOTE: USE CENTER GAUGE, SEE REF. #1, PP. 36-31

TASK SHEET

JOB: EL-9a
TASK: 7
PAGE: 1

TASK: THREAD ONE END OF WORK PIECE

JOB: MAKE TWO T-BOLTS

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, THREADING TOOL, CENTER GAUGE, WORK PIECE, 6" STEEL RULE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WORK	1. MOUNT LATHE DOG ON EITHER END OF WORK PIECE 2. SET UP WORK BETWEEN CENTERS
2. POSITION TOOL	1. PUT SAFETY GOGGLES ON 2. START MACHINE IN FORWARD MOTION 3. HAND FEED THE CARRIAGE AND CROSS SLIDE TO POSITION TOOL POINT 1/8" FROM WORK PIECE AND NEAR RIGHT END
3. LAYOUT WORK PIECE	THE LAYOUT 1 1/8" LENGTH TO BE THREADED NOTE: USE 6" STEEL RULE AND PENCIL
4. SET MICROMETER	1. TURN CROSS SLIDE HANDLE SLOWLY CLOCKWISE UNTIL THE TOOL POINT TOUCHES PART 2. MOVE CARRIAGE TO THE RIGHT UNTIL TOOL POINT IS OFF THE PART 3. SET THE MICROMETER DIAL ON THE CROSS SLIDE TO ZERO 4. SET THE MICROMETER DIAL ON THE COMPOUND REST TO ZERO
5. CUT FIRST THREAD	1. ADVANCE TOOL .005" WITH THE COMPOUND REST DIAL 2. ENGAGE HALF-NUT LEVER NOTE: FOR EVEN NUMBER THREADS ENGAGE THE LEVER WHEN ANY NUMBERED LINE ON THE DIAL IS IN LINE

5. CUT FIRST THREAD (CON'T.)

WITH THE INDEX LINE ON THE OUTER RING OF THE THREAD DIAL INDICATOR. FOR ODD NUMBERED THREADS USE ODD NUMBERS ONLY (1 AND 3)

3. USE CUTTING OIL FREELY
4. WHEN TOOL POINT THREADS TO LAYOUT LINE, DISENGAGE THE HALF-NUT LEVER
5. TURN CROSS FEED HANDLE TO THE LEFT TWO OR THREE TURNS TO WITHDRAW TOOL FROM WORK
6. BRING CARRIAGE BACK TO STARTING POINT OF CUT
7. TURN CROSS FEED HANDLE TO THE RIGHT UNTIL IT READS ZERO AT THE SAME PLACE THE FIRST CUT WAS TAKEN

   NOTE: THIS IS THE ORIGINAL ZERO STARTING POINT
8. TURN COMPOUND REST HANDLE .005" TO THE RIGHT
9. REPEAT SAME PROCEDURE AS BEFORE REMOVING ABOUT .005" PER CUT UNTIL DESIRED DEPTH IS OBTAINED

   NOTE: THE FINAL THREE CUTS SHOULD BE MADE REMOVING ONLY ABOUT .001" PER CUT

SKETCHES: DRAWING #21: T-HEAD BOLTS

TASK SHEET

JOB: EL-9a
TASK: 10
PAGE: 1

TASK: UNDERCUT WITH CUT-OFF OR PARTING TOOL

JOB: MAKE TWO T-BOLTS

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. LAYOUT WORK PIECE	LAYOUT WORK PIECE 2 7/16" FROM EACH END AS PER DRAWING NOTE: THERE SHOULD BE 1/4" BETWEEN THE LAYOUT LINES
2. SET UP WORK PIECE	REPEAT TASK 3
3. SET UP MACHINE	1. DISENGAGE THE THREAD DIAL 2. SLOW RPM TO 1/3 OF THE PRESENT SPEED
4. SET UP CUT-OFF OR PARTING TOOL	1. MOUNT CUT-OFF OR PARTING TOOL IN TOOL POST 2. MOUNT TOOL PERPENDICULAR TO THE WORK PIECE 3. POINT OF TOOL MUST BE ON CENTER LINE
5. POSITION TOOL	1. TURN MACHINE ON 2. MOVE CROSS SLIDE HANDLE AND CARRIAGE HANDWHEEL UNTIL POINT OF TOOL IS BETWEEN LAYOUT LINES AND 1/16" FROM WORK PIECE 3. MOVE CARRIAGE EITHER DIRECTION UNTIL SIDE OF TOOL IS ON CENTER OF LAYOUT LINE 4. LOCK CARRIAGE WITH CARRIAGE LOCK NUT
6. UNDERCUT	1. MOVE CROSS SLIDE IN SLOWLY UNTIL TOOL TOUCHES WORK PIECE 2. CONTINUE TO MOVE TOOL IN SLOWLY .875" TO HOLD 5/8" DIAMETER

6. UNDERCUT (CON'T.)	NOTE: OIL FREELY 3. CHECK DIAMETER WITH OUTSIDE CALIPERS OR VERNIER CALIPERS 4. WHEN 5/8" DIAMETER IS HELD, MOVE CROSS SLIDE OUT UNTIL TOOL POINT IS OUT OF WORK PIECE 5. LOOSEN CARRIAGE LOCK NUT 6. MOVE CARRIAGE TO POSITION SIDE OF TOOL ON OTHER LAYOUT LINE. REPEAT SAME PROCEDURE AS BEFORE TO HOLD 1/4" WIDTH
7. INSPECT	1. 5/8" DIAMETER X 2" LENGTH ON BOTH ENDS 2. THREADS (CHECK WITH A NUT) 3. 1/4" WIDTH X 5/8" DIAMETER UNDERCUT

ROUTE TO MILL

SKETCHES: DRAWING #21: T-HEAD BOLTS

HM-8

JOB SHEET
IN
MILLING MACHINE

JOB: MAKE TWO T-HEAD BOLTS

MATERIALS: ONE PIECE COLD ROLLED STEEL TURNED TO SIZE

TOOLS AND EQUIPMENT: HORIZONTAL MILLING MACHINE, DIVIDING HEAD WITH TAIL STOCK, LATHE DOG, 1" ARBOR WITH COLLARS, HELICAL SLAB MILLING CUTTER WITH 1" DIAMETER HOLE, 1"-2" MICROMETERS, DIAL INDICATOR

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 38-1 TO 38-37 AND REF. #2, PP. 524 TO 564. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

HM-8-1	CHECK MACHINE FOR PROPER RUNNING CONDITION, T-NUT, HM-1-1
HM-8-2	SET UP DIVIDING HEAD AND TAILSTOCK
HM-8-3	SET UP ARBOR AND CUTTER, T-NUT, HM-1-3
HM-8-4	MILL FIRST SIDE OF WORK PIECE
HM-8-5	MILL SECOND SIDE

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. MACHINE SET UP PROPERLY.
2. DIVIDING HEAD SET UP PROPERLY.
3. CUTTER ROTATION AND FEED IN CORRECT DIRECTION.
4. ALL DIMENSIONS HELD TO SPECIFICATIONS.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: HM-8
TASK: 2
PAGE: 1

TASK:	SET UP DIVIDING HEAD AND TAILSTOCK
JOB:	MAKE TWO T-BOLTS
TRADE:	MACHINIST
TOOLS AND MATERIALS:	HORIZONTAL MILLING MACHINE, WORK PIECE, DIVIDING HEAD, TAILSTOCK, HELICAL SLAB MILL CUTTER, TEST BAR, DIAL INDICATOR

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP DIVIDING HEAD	1. CLEAN MACHINE TABLE WITH RAG
	2. CLEAN BOTTOM OF DIVIDING HEAD WITH RAG
	3. CLEAN BOTTOM OF TAILSTOCK WITH RAG
	4. SET DIVIDING HEAD ON RIGHT END OF MACHINE TABLE NOTE: THE CENTER POINT SHOULD BE POINTING TOWARD OPPOSITE END OF TABLE AND LOCATED AT CENTER OF MILL TABLE
	5. INSERT T-BOLTS IN SLOTS ON TABLE AND BOLT DIVIDING HEAD TO TABLE NOTE: ONLY SNUG NUTS ON "T" BOLTS
2. SET UP TAILSTOCK	1. SET TAILSTOCK ON MILL TABLE NOTE: THE CENTER POINT SHOULD BE POINTING TOWARD DIVIDING HEAD NOTE: TAILSTOCK POSITION SHOULD BE ADJUSTED TO ALLOW WORK PIECE TO BE SET UP BETWEEN CENTERS
	2. INSERT T-BOLTS IN SLOTS ON TABLE AND BOLT TAILSTOCK DOWN NOTE: ONLY SNUG NUTS ON T-BOLTS NOTE: ON THIS PARTICULAR JOB IT IS NOT NECESSARY FOR THE DIVIDING HEAD AND TAILSTOCK TO BE SET UP PERFECTLY PARALLEL TO TABLE BUT IT IS RECOMMENDED THAT IT BE DONE ON EVERY JOB TO TEACH PERFECTION

2.	SET UP TAILSTOCK (CON'T.)	3.	LOCK THE DIVIDING HEAD REVOLVING MECHANISM
3.	INDICATE DIVIDING HEAD TRUE	1.	USE TEST BAR OF SAME LENGTH AS WORK PIECE
		2.	PLACE BAR BETWEEN CENTERS
		3.	INDICATE LENGTH TRUE WITH DIAL INDICATOR
		4.	TIGHTEN T-BOLT NUTS
		5.	RECHECK WITH INDICATOR
4.	MOUNT WORK PIECE	1.	MOUNT LATHE DOG ON EITHER END OF WORK PIECE
		2.	USE A SOFT SHIM AROUND THREADS TO PROTECT THEM
		3.	PLACE WORK PIECE BETWEEN CENTERS NOTE: LATHE DOG TAIL MUST BE BETWEEN DOG COLUMNS ON DIVIDING HEAD AND NOT IN A BIND
		4.	TIGHTEN COLUMN SET SCREWS AGAINST TAIL OF LATHE DOG
		5.	SET MACHINE FEED AND SPEED NOTE: REFER TO REF. #1, PP. 38-17 OR REF. #2, PP. 548-550 TO DETERMINE THE PROPER RPM AND FEED FOR THE TYPE OF CUTTER BEING USED

SKETCHES: DRAWING #21: T-HEAD BOLTS

TASK SHEET

JOB: HM-8
TASK: 4
PAGE: 1

TASK:	MACHINE FIRST SIDE OF WORK PIECE
JOB:	MAKE TWO T-BOLTS
TRADE:	MACHINIST
TOOLS AND MATERIALS:	HORIZONTAL MILLING MACHINE, DIVIDING HEAD, HELICAL SLAB MILL CUTTER, TAILSTOCK, TEST BAR, DIAL INDICATOR, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION WORK PIECE	1. PUT SAFETY GOGGLES ON 2. START MACHINE NOTE: BE SURE CUTTER IS REVOLVING IN PROPER DIRECTION 3. TURN THE ELEVATION HANDLE, CROSS SLIDE HANDLE, AND TABLE LONGITUDINAL HANDLE UNTIL WORK PIECE IS POSITIONED DIRECTLY BENEATH CUTTER AND 1/16" BELOW CUTTER
2. MAKE FINAL ADJUSTMENTS	1. RAISE TABLE SLOWLY UNTIL CUTTER JUST TOUCHES WORK PIECE NOTE: A THIN PIECE OF PAPER BETWEEN CUTTER AND WORK PIECE WILL HELP 2. TURN LONGITUDINAL TABLE HANDWHEEL UNTIL WORK PIECE IS 2" CLEAR OF CUTTER 3. SET ELEVATION MICROMETER DIAL ON ZERO 4. RAISE TABLE .250" BY THE DIAL
3. MACHINE FIRST SIDE	1. TURN TABLE HANDWHEEL UNTIL CUTTER BEGINS TO CUT WORK PIECE 2. TURN ON COOLANT PUMP 3. ENGAGE AUTOMATIC FEED NOTE: BE SURE TO USE THE CONVENTIONAL CUTTING AND NOT CLIMB CUTTING 4. TURN MACHINE OFF

SKETCHES: DRAWING #21: T-HEAD BOLTS

TASK SHEET

JOB: HM-8
TASK: 5
PAGE: 1

TASK: MILL SECOND SIDE

JOB: MAKE TWO T-BOLTS

TRADE: MACHINIST

TOOLS AND MATERIALS: HORIZONTAL MILLING MACHINE, DIVIDING HEAD, HELICAL SLAB MILL CUTTER, TAILSTOCK, TEST BAR, DIAL INDICATOR, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP TO MACHINE SECOND SIDE	1. TURN TABLE LONGITUDINAL HANDWHEEL UNTIL WORK PIECE IS 2" FROM CUTTER
	2. LOOSEN DIVIDING HEAD REVOLVING MECHANISM
	3. TURN DIVIDING HEAD INDEXING HANDLE EXACTLY TWENTY TURNS IN EITHER DIRECTION
	4. LOCK THE DIVIDING HEAD REVOLVING MECHANISM NOTE: IT WILL NOT BE NECESSARY TO CHANGE THE ELEVATION
2. MACHINE WORK PIECE	1. TURN LONGITUDINAL TABLE TRAVEL UNTIL CUTTER BEGINS TO CUT
	2. TURN ON COOLANT PUMP
	3. ENGAGE AUTOMATIC FEED
	4. WHEN CUT IS COMPLETE TURN COOLANT PUMP OFF
	5. TURN MACHINE OFF
	6. REMOVE WORK PIECE FROM MACHINE
	7. CLEAN WORK PIECE AND MACHINE
	8. RETURN DIVIDING HEAD AND TAILSTOCK TO STORAGE AREA
3. INSPECT	1" WIDTH

ROUTE TO LATHE

SKETCHES: DRAWING #21: T-HEAD BOLTS

JOB SHEET
IN
ENGINE LATHE

JOB:	MAKE TWO T-HEAD BOLTS
MATERIALS:	ONE PIECE COLD ROLLED STEEL TURNED TO SIZE AND MILLED
TOOLS AND EQUIPMENT:	ENGINE LATHE, INDEPENDENT CHUCK, TOOL HOLDER, FACING TOOL BIT, CUT-OFF OR PARTING TOOL
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 36-1 TO 36-44 AND REF. #2, PP. 462 TO 493. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:	EL-9b-1	REMOVE FACE PLATE FROM LATHE AND INSTALL INDEPENDENT CHUCK, STUD, EL-1-2b AND JIG BUSHING, EL-5-2
	EL-9b-2	MOUNT THE WORK PIECE IN INDEPENDENT CHUCK NOTE: A UNIVERSAL CHUCK WILL NOT HOLD WORK PIECE SECURE FOR PARTING. USE SHIM STOCK TO PROTECT WORK PIECE. CAUTION: PARTING CANNOT BE DONE BETWEEN CENTERS
	EL-9b-3	SET UP MACHINE FOR PARTING, EL-9a-10
	EL-9b-4	PART WORK PIECE
	EL-9b-5	FACE HEAD OF T-BOLT
	EL-9b-6	FACE HEAD OF SECOND T-BOLT, (TASK 5)

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. MACHINE SET UP PROPERLY.
2. WORK PIECE SET UP PROPERLY.
3. BOLT HEADS FACED SMOOTH AND TO SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: EL-9b
TASK: 4
PAGE: 1

TASK: PART WORK PIECE

JOB: MAKE TWO T-BOLTS

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, INDEPENDENT CHUCK, TOOL HOLDER, CUT-OFF OR PARTING TOOL, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. SET UP WORK PIECE	1. IN LATHE 2. AS IN PRECEDING TASKS
2. POSITION TOOL	TURN TABLE LONGITUDINAL HAND-WHEEL AND CROSS SLIDE HANDLE TO POSITION POINT OF PARTING TOOL IN CENTER OF 1/4" UNDERCUT
3. PART WORK PIECE	1. PUT SAFETY GOGGLES ON 2. TURN MACHINE ON 3. PART WORK COMPLETELY IN SAME MANNER AS UNDERCUTTING NOTE: USE CUTTING OIL FREELY 4. TURN MACHINE OFF 5. REMOVE PARTING TOOL

SKETCHES: DRAWING #21: T-HEAD BOLTS

TASK SHEET

JOB: EL-9b
TASK: 5
PAGE: 1

TASK: FACE HEAD OF T-BOLT

JOB: MAKE TWO T-BOLTS

TRADE: MACHINIST

TOOLS AND MATERIALS: ENGINE LATHE, FACING TOOL, WORK PIECE

T[illegible] BREAKDOWN:

STEPS	KEY POINTS
1. INSTALL TOOL	1. SELECT PROPER FACING TOOL
	2. MOUNT TOOL IN TOOL HOLDER
	3. PLACE TOOL HOLDER IN TOOL POST
	4. ADJUST TOOL TO POSITION FOR FACING
	5. TIGHTEN TOOL HOLDER
2. SET FEED AND SPEED	1. DISENGAGE BACK GEAR
	2. SET MACHINE AT 500 RPM
	3. SET AUTOMATIC FEED TO REMOVE .008" PER CHIP REVOLUTION
3. POSITION TOOL	1. MOVE CARRIAGE AND COMPOUND REST TO POSITION TOOL AT END OF WORK PIECE
	2. SET TOOL POST ON LEFT SIDE OF COMPOUND REST
	3. READJUST TOOL HOLDER UNTIL TOOL POINT WILL PASS THROUGH EXACT CENTER OF WORK
4. FACE END	1. PUT SAFETY GOGGLES ON
	2. START MACHINE
	3. MOVE COMPOUND REST TO LEFT
	4. ENGAGE FEED LEVER
	5. DISENGAGE FEED LEVER WHEN TOOL REACHES CENTER OF WORK PIECE
	6. TURN COMPOUND REST HANDLE COUNTERCLOCKWISE TO RETURN TOOL TO STARTING POSITION
	7. FACE TO HOLD 7/16" THICKNESS OF BOLT HEAD

4. FACE END (CON'T.)	8. STOP MACHINE
5. INSPECT T-BOLT	1. 1 1/8" LENGTH 2. 2" LENGTH (1 1/8" + 7/8") 3. 7/16" THICKNESS 4. 5/8" DIAMETER 5. 1/16" X 45° CHAMFER 6. CHECK THREADS WITH 5/8"-11 N. C. NUT

SKETCHES: DRAWING #21: T-HEAD BOLTS

MACHINE SHOP PLANER BOLT

ENGINE LATHE 10

MILLING 10/HM-9

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND MAKE PLANER BOLTS ACCORDING TO SPECIFICATIONS; USING TOOLS, MACHINES, EQUIPMENT, AND MATERIALS CALLED FOR IN THE JOB.

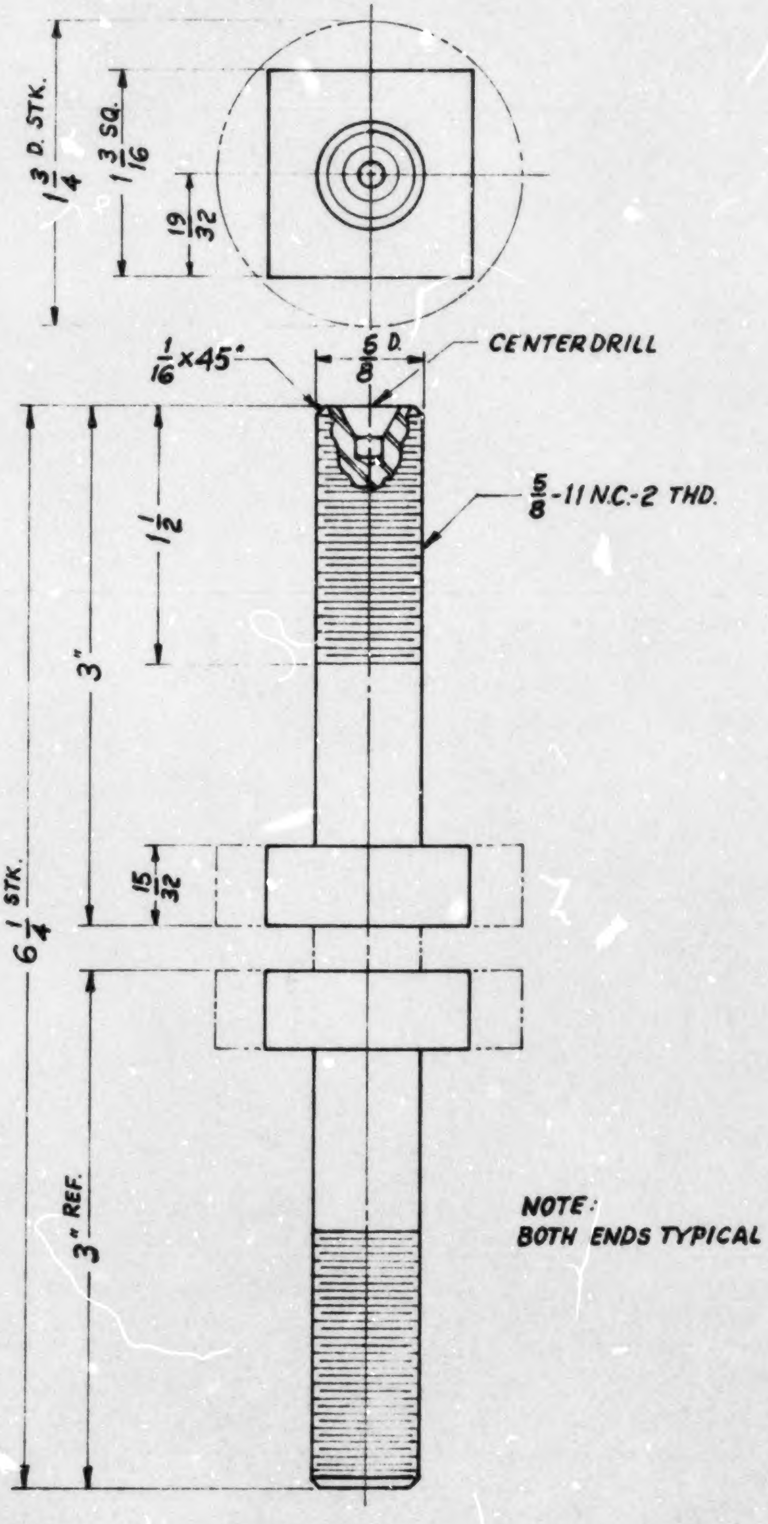
CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.


1 3/4 D. STK.
1 3/16 SQ.
19/32
1/16 x45°
5/8 D.
CENTERDRILL
5/8-11 N.C.-2 THD.
1 1/2
3"
15/32
6 1/4 STK.
3" REF.
NOTE:
BOTH ENDS TYPICAL

DRAWING NO. 22	PLANER BOLTS	TOLERANCES UNLESS OTHERWISE NOTED
LATHE JOB NO.10 MILLING JOB NO.10	MATERIAL: C.R. STEEL FINISH: TOOL & FILE SCALE: FULL SIZE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4°

EL-10a

JOB SHEET
IN
ENGINE LATHE

JOB: MAKE TWO PLANER BOLTS

MATERIALS: ONE PIECE 1 3/4" ROUND X 6 1/4" LONG COLD ROLLED STEEL

TOOLS AND EQUIPMENT: ENGINE LATHE, FACE PLATE, TOOL HOLDER, 1" MICROMETER, ONE LIVE CENTER, TOOL BIT, THREADING TOOL, CUT OFF OR PARTING TOOL, 5/8"-11 N. C. THREAD GAUGE, OIL CAN AND CUTTING OIL, ONE DEAD CENTER

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 36-1 TO 36-44 AND REF. #2, PP. 462-493. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

EL-10a-1	CHECK LATHE FOR PROPER RUNNING CONDITION, STUD, EL-1-1
EL-10a-2	FACE AND CENTER DRILL BOTH ENDS OF STOCK, TEST BAR, EL-2-3, EL-2-4
EL-10a-3	SET UP LATHE TO WORK BETWEEN CENTERS, TEST BAR, EL-2-6
EL-10a-4	TURN WORK PIECE, TEST BAR, EL-2-7 NOTE: HOLD 5/8" DIAMETER AND 2 17/32" LENGTH ON ONE END
EL-10a-5	REVERSE WORK PIECE BETWEEN CENTERS AND TURN OPPOSITE END TO SIZE, (TASK 4) NOTE: PROTECT WORK PIECE, T-HEAD BOLTS, HM-8-2
EL-10a-6	SET UP LATHE TO CUT THREADS, T-HEAD BOLTS, EL-9-6
EL-10a-7	THREAD ONE END OF WORK PIECE, T-HEAD BOLTS, EL-9-7
EL-10a-8	THREAD OPPOSITE END OF WORK PIECE, T-HEAD BOLTS, EL-9-9
EL-10a-9	UNDERCUT WITH CUT-OFF OR PARTING TOOL, T-HEAD BOLTS, EL-9-10

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. OIL RESERVOIRS FILLED TO PROPER LEVEL.
2. MACHINE SET UP PROPERLY.
3. ALL DIMENSIONS HELD TO SPECIFICATIONS.

4. 5/8" N. C. NUT FITS THREADS PROPERLY.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

SKETCHES: DRAWING #22: PLANER BOLTS

JOB SHEET
IN
MILLING MACHINE

HM-9

JOB: MAKE TWO PLANER BOLTS

MATERIALS: ONE PIECE 1 3/4" ROUND X 6 1/4" LONG COLD ROLLED STEEL

TOOLS AND EQUIPMENT: HORIZONTAL MILLING MACHINE, DIVIDING HEAD WITH TAILSTOCK, LATHE DOG, 1" ARBOR AND COLLARS, HELICAL SLAB MILLING CUTTER WITH 1" DIAMETER HOLE, DIAL INDICATOR, 1"-2" MICROMETERS

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 38-1 TO 38-37 AND REF. #2, PP. 524 TO 564. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

HM-9-1	CHECK MACHINE FOR PROPER RUNNING CONDITION, T-NUT, HM-1-1
HM-9-2	SET UP DIVIDING HEAD AND TAILSTOCK AND MOUNT WORK PIECE, T-HEAD BOLTS, HM-8-2
HM-9-3	SET UP ARBOR AND CUTTER, T-NUT, HM-1-3
HM-9-4	MILL FIRST SIDE, RAISE TABLE 9/32", T-HEAD BOLTS, HM-8-4
HM-9-5	MILL SECOND SIDE, T-HEAD BOLTS, HM-8-5 NOTE: ANY INDEXING PLATE IS ACCEPTABLE. TO REVOLVE WORK PIECE 90° TURN DIVIDING HEAD HANDLE EXACTLY TEN COMPLETE TURNS IN EITHER DIRECTION
HM-9-6	MILL THIRD SIDE, (TASK 5)
HM-9-7	MILL FOURTH SIDE, (TASK 5)

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. MACHINE SET UP PROPERLY.
2. DIVIDING HEAD SET UP PROPERLY.
3. CUTTER FEED AND ROTATION CORRECT.
4. HOLD ALL DIMENSIONS TO DRAWING.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

SKETCHES: DRAWING #22: PLANER BOLTS

JOB SHEET
IN
ENGINE LATHE

EL-10b

JOB:	MAKE TWO PLANER BOLTS
MATERIALS:	C. R. PART THAT HAS BEEN MILLED
TOOLS AND EQUIPMENT:	ENGINE LATHE, TOOL HOLDER, FACING TOOL BIT, INDEPENDENT CHUCK, CUT-OFF OR PARTING TOOL
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 36-1 TO 36-44 AND REF. #2, PP. 462 TO 493. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

EL-10b-1	REMOVE FACE PLATE FROM LATHE AND INSTALL THE INDEPENDENT CHUCK, STUD, EL-1-2b
EL-10b-2	SET UP THE WORK PIECE, T-HEAD BOLTS, EL-9-2
EL-10b-3	SET UP MACHINE FOR PARTING, T-HEAD BOLTS, EL-9a-10
EL-10b-4	SET UP PARTING TOOL, T-HEAD BOLTS, EL-9b-3
EL-10b-5	PART WORK PIECE, T-HEAD BOLTS, EL-9b-4
EL-10b-6	FACE HEAD OF BOLT IN CHUCK, T-HEAD BOLTS, EL-9b-5
EL-10b-7	FACE HEAD OF SECOND BOLT, T-HEAD BOLTS, EL-9b-6

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. MACHINE SET UP PROPERLY.
2. WORK PIECE SET UP PROPERLY.
3. BOLT HEADS FACED SMOOTH AND TO SPECIFICATIONS.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

SKETCHES: DRAWING #22: PLANER BOLTS

MACHINE SHOP FILLISTER HEAD CAP SCREW

TURRET LATHE 4

MILLING 11/HM-10

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND MAKE SEVERAL FILLISTER HEAD CAP SCREWS ACCORDING TO SPECIFICATIONS; USING TOOLS, MACHINES, EQUIPMENT, AND MATERIALS CALLED FOR IN THE JOB.

CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

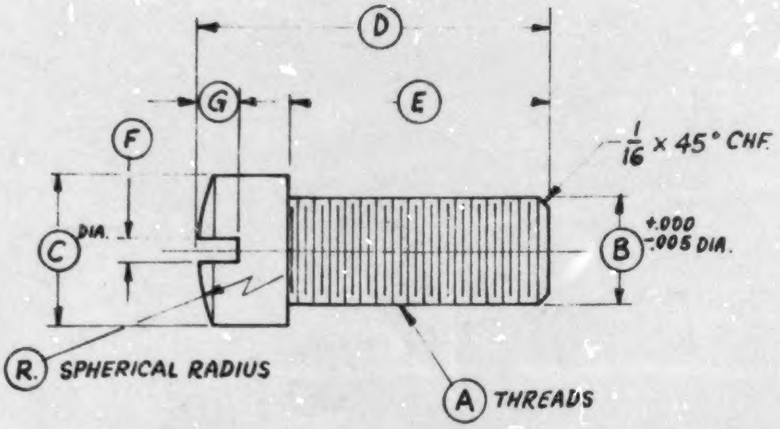
REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.

REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS.

NOTE: THE TASK SHEETS FOR THIS JOB ARE DESIGNED FOR REF. #5 ON DRAWING #23. IF OTHER SIZES ARE DESIRED, DIMENSIONS MUST BE CHANGED ACCORDINGLY.


D
G
E
F
1/16 × 45° CHF.
C DIA.
B +.000 -.005 DIA.
R. SPHERICAL RADIUS
A THREADS

REF. NO.	"A" THD.S	"B" DIA	"C" DIA.	"D"	"E"	"F"	"G"	"R"
1	1/4-20 N.C.	.250	3/8	23/32	1/2	.070	.097	13/32
2	5/16-18 N.C.	.312	7/16	3/4	1/2	.079	.115	9/16
3	3/8-16 N.C.	.375	9/16	1 1/16	3/4	.088	.142	11/16
4	1/2-13 N.C.	.500	3/4	1 13/32	1	.110	.188	1 11/32
5	5/8-11 N.C.	.625	7/8	2 1/32	1 1/2	.138	.240	1 1/8

DRAWING NO. 23

FILLISTER HEAD CAP SCREW

TOLERANCES UNLESS OTHERWISE NOTED

TURRET LATHE JOB NO. 4
MILLING JOB NO. 11

MATERIAL: C.R. STEEL
FINISH: TOOL
SCALE: FULL SIZE

FRACTIONS . ± 1/64"
DECIMAL . ± .005"
ANGLES . ± 1/4°

JOB SHEET
IN
TURRET LATHE

TL-3

JOB:	MAKE PRESCRIBED NUMBER OF FILLISTER HEAD CAP SCREWS
MATERIALS:	ONE BAR OF 7/8" COLD ROLLED STEEL
TOOLS AND EQUIPMENT:	TURRET LATHE, BOX TOOL, SOLID OR COLLAPSIBLE DIE, CHAMFERING TOOL, COMBINATION PARTING AND FORMING TOOL, FEED FINGERS, 7/8" COLLET, STOCK STOP, 1" MICROMETER, THREAD GAUGE, FLAT FILE, 6" OR 12" RULE, BAR STOCK SUPPORT
GENERAL INSTRUCTIONS:	BEFORE BEGINNING THIS JOB REVIEW REF. #3, P. 201. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

TL-3-1	CHECK TURRET LATHE FOR PROPER RUNNING CONDITION, STEEL WASHERS, TL-1-1
TL-3-2	INSTALL 7/8" COLLET IN SPINDLE OF MACHINE, STEEL WASHERS, TL-1-2
TL-3-3	INSTALL PROPER FEED FINGERS, STEEL WASHERS, TL-1-2
TL-3-4	INSTALL TURRET TOOLS AND SET CORRESPONDING STOPS, STEEL WASHERS, TL-1-2 SUGGESTED LAYOUT: a. STOCK STOP b. BOX TURNING TOOL c. THREADING DIE, 5/8"-11 N. C.
TL-3-5	INSTALL TOOLS IN TURRET TOOL POST AND CORRESPONDING STOPS, STEEL WASHERS, TL-1-2 SUGGESTED LAYOUT: a. CHAMFERING TOOL b. COMBINATION FORMING AND CUT-OFF TOOL
TL-3-6	SET FEEDS AND SPEEDS, STEEL WASHERS, TL-1-2
TL-3-7	MAKE ONE FILLISTER HEAD CAP SCREW
TL-3-8	MAKE REQUIRED NUMBER IN PRODUCTION MANNER, (TASK 7) NOTE: SPOT CHECK ONE IN EVERY TEN. WHEN JOB IS COMPLETED, RETURN UNUSED BAR STOCK AND CLEAN MACHINE AND WORK AREA

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. MACHINE SET UP PROPERLY.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. 5/8"-11 N. C. NUT FITS PROPERLY.
4. BOX TURNING TOOL SET PROPERLY.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.
6. STUDENT IS TO SEEK SPEED AS REQUIRED IN PRODUCTION SHOPS.

TASK SHEET

JOB: TL-3
TASK: 7
PAGE: 1

TASK: MAKE ONE FILLISTER HEAD CAP SCREW

JOB: MAKE A FILLISTER HEAD CAP SCREW

TRADE: MACHINIST

TOOLS AND MATERIALS: TURRET LATHE, BOX TOOL, SOLID OR COLLAPSIBLE DIE, WORK PIECE, CHAMFERING TOOL, COMBINATION PARTING AND FORMING TOOL, FEED FINGERS, 7/8" COLLET, STOCK STOP, 1" MICROMETER, THREAD GAUGE, FLAT FILE, 6" OR 12" RULE, BAR STOCK SUPPORT

TASK BREAKDOWN:

STEPS	KEY POINTS
1. PREPARE TO MACHINE FIRST PART	1. PUT SAFETY GOGGLES ON 2. START MACHINE NOTE: AFTER EACH CUT IT WILL BE NECESSARY TO STOP THE MACHINE AND CHECK EACH DIMENSION BEING CUT AND, IF NECESSARY, READJUST THE CORRESPONDING STOP
2. SET MATERIAL	1. REVOLVE THE TAILSTOCK TURRET TO STOCK STOP 2. MOVE TURRET TOWARD HEADSTOCK END OF MACHINE WITH TURRET HANDWHEEL 3. HOLD TAILSTOCK TURRET AGAINST STOP WITH RIGHT HAND 4. ADVANCE BAR STOCK WITH LEFT HAND UNTIL THE END IS AGAINST STOCK STOP 5. LOCK BAR STOCK IN POSITION BY RELEASING HANDLE IN LEFT HAND
3. TURN DIAMETER	1. REVOLVE TAILSTOCK TURRET TO BOX TURNING TOOL 2. START MACHINE IN FORWARD MOTION 3. TURN COOLANT PUMP ON 4. ADVANCE TURRET TURNING TOOL UNTIL TOOL TOUCHES WORK PIECE 5. ENGAGE AUTOMATIC FEED NOTE: HOLD 5/8" DIAMETER BY 1 1/2" LONG

4. THREAD WORK PIECE	1. REVOLVE THE TAILSTOCK TURRET TO THREADING DIE 2. ADVANCE TURRET THREADING DIE UNTIL DIE TOUCHES WORK PIECE 3. ENGAGE AUTOMATIC FEED 4. CHECK THREADS WITH A NUT NOTE: AFTER THREADING RETURN TAILSTOCK TURRET TO END OF LATHE BED AND REVOLVE TO STOCK STOP TO BE READY FOR NEXT PART
5. CHAMFER	1. REVOLVE THE TOOL POST TURRET TO CHAMFERING TOOL 2. HAND FEED CROSS SLIDE UNTIL CHAMFER IS 1/16" DEEP 3. SET MICROMETER DIAL ON ZERO NOTE: THERE ARE NO STOPS ON CROSS FEED. CAUTION MUST BE TAKEN TO PREVENT CUTTING TOO DEEP
6. REMOVE BURRS AND PART WORK	1. RETRACT THE CROSS SLIDE SEVERAL ROUNDS 2. REVOLVE TOOL POST TURRET UNTIL COMBINATION FORMING AND CUT-OFF TOOL IS IN POSITION 3. HAND FEED TOOL INTO WORK 4. ENGAGE AUTOMATIC FEED 5. PICK UP FLAT FILE NOTE: BE SURE FILE HAS HANDLE ON IT 6. REMOVE MACHINE BURRS BY HAND WHILE CUT-OFF TOOL IS PARTING THE WORK PIECE NOTE: COMBINATION FORMING TOOL AND CUT-OFF TOOL SHOULD HOLD 17/32" WIDTH, 2 1/32" LENGTH, AND 1 1/8" R. 7. TURN MACHINE OFF
7. INSPECT	CHECK THE FOLLOWING DIMENSIONS: a. $.625^{+.000}_{-.005}$ b. 5/8"-11 N. C. THREADS c. 2 1/32" LENGTH d. 7/8" DIAMETER e. 17/32" LENGTH

7. INSPECT (CON'T.)

f. 1 1/2" LENGTH

g. 1 1/8" RADII

SKETCHES: DRAWING #23: FILLISTER HEAD CAP SCREW

HM-10

JOB SHEET
IN
MILLING

JOB: MAKE PRESCRIBED NUMBER OF FILLISTER HEAD CAP SCREWS

MATERIALS: PARTS MADE ON TURRET LATHE

TOOLS AND EQUIPMENT: HORIZONTAL MILLING MACHINE, MILLING MACHINE VISE, SMALL V BLOCK, 1/8" SLITTING SAW, ARBOR AND COLLARS, TWO PARALLEL BARS, BRASS OR COPPER SHIM STOCK

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 38-1 TO 38-37 AND REF. #2, PP. 524 TO 564. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

HM-10-1	CHECK MACHINE FOR PROPER RUNNING CONDITION, T-NUT, HM-1-1
HM-10-2	SET UP VISE ON MILL TABLE, T-NUT, HM-1-2 NOTE: IT IS NOT NECESSARY TO INDICATE VISE TRUE. IN CASE A LARGE QUANTITY OF SCREWS ARE TO BE SLOTTED, A SIMPLE HOLDING FIXTURE SHOULD BE MADE
HM-10-3	SET UP HORIZONTAL MILL, T-NUT, HM-1-2 NOTE: MOUNT 1/8" SLITTING SAW ON ARBOR, CHECK REFERENCES FOR FEED AND SPEED
HM-10-4	SET UP V BLOCK AND PART
HM-10-5	MACHINE SLOT

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. MACHINE SET UP PROPERLY.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. SLIT IS SQUARE AND TRUE.
4. V BLOCK SET SCREW MUST NOT BE DAMAGING THREADS.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.

TASK SHEET

JOB: HM-10
TASK: 4
PAGE: 1

TASK:	SET UP V BLOCK AND PART
JOB:	MAKE A FILLISTER HEAD CAP SCREW
TRADE:	MACHINIST
TOOLS AND MATERIALS:	MILLING MACHINE VISE, PARALLEL BARS, SMALL V BLOCK, BRASS OR COPPER SHIM STOCK

TASK BREAKDOWN:

STEPS	KEY POINTS
1. CLEAN VISE	1. OPEN VISE ABOUT 3" WIDTH 2. WIPE VISE CLEAN INSIDE JAWS
2. PREPARE PARALLEL BARS	1. WIPE PARALLEL BARS CLEAN 2. LAY PARALLEL BARS IN VISE
3. CLAMP V BLOCK	1. SET V BLOCK ON PARALLEL BARS NOTE: PLACE V IN WHICH CAP SCREWS WILL BE LOCATED PERPENDICULAR TO TABLE AND FACING THE DIRECTION OF TRAVEL NOTE: MILLING MUST BE CONVENTIONAL (SEE REF. #2, P. 534) 2. TIGHTEN VISE
4. SET UP PART	1. SET CAP SCREW IN V BLOCK, HEAD UP NOTE: LET HEAD OF SET SCREW SIT ON TOP OF V BLOCK 2. PLACE BRASS OR COPPER SHIM BETWEEN CAP SCREW AND CLAMP SCREW 3. TIGHTEN CLAMP SCREW

SKETCHES: DRAWING #23: FILLISTER HEAD CAP SCREWS

TASK SHEET

JOB: HM-10
TASK: 5
PAGE: 1

TASK: MACHINE SLOT

JOB: FILLISTER HEAD CAP SCREWS

TRADE: MACHINIST

TOOLS AND MATERIALS: HORIZONTAL MILLING MACHINE, ARBOR AND COLLARS, 1/8" SLITTING SAW, WORK PIECE

TASK BREAKDOWN:

STEPS	KEY POINTS
1. POSITION TABLE	TURN TABLE LONGITUDINAL TRAVEL HANDWHEEL, CROSS SLIDE HANDWHEEL, AND ELEVATION HANDLE TO POSITION WORK PIECE ABOUT 1/16" BELOW SAW CUTTER
2. SET DEPTH	1. PUT SAFETY GOGGLES ON
	2. TURN MACHINE ON NOTE: BE SURE CUTTER SAW IS TURNING IN RIGHT DIRECTION FOR CONVENTIONAL MILLING
	3. RAISE TABLE SLOWLY UNTIL WORK PIECE OR CAP SCREW TOUCHES REVOLVING SAW NOTE: PAPER MAY BE USED
	4. TURN CROSS SLIDE HANDWHEEL CLOCKWISE TO MOVE TABLE IN 1"
	5. RAISE TABLE .240" WITH THE MICROMETER DIAL
	6. DISENGAGE ELEVATION HANDLE
	7. LOCK KNEE LOCKS
3. SET SLITTING SAW ON CENTER LINE OF CAP SCREW	1. TURN CROSS SLIDE HANDWHEEL COUNTERCLOCKWISE TO MOVE TABLE OUT SLOWLY
	2. PLACE PAPER BETWEEN SLITTING SAW AND CAP SCREW HEAD
	3. WHEN CUTTER CUTS PAPER SET MICROMETER DIAL ON ZERO
	4. TURN TABLE LONGITUDINAL TRAVEL HANDWHEEL UNTIL THE WORK PIECE IS

3. SET SLITTING SAW ON CENTER LINE OF CAP SCREW (CON'T.)	COMPLETELY CLEAR OF CUTTER NOTE: THE DIRECTION IN WHICH THE TABLE IS MOVED LONGITUDINALLY DEPENDS ON THE SETUP. REMEMBER TO CUT CONVENTIONAL 5. TURN CROSS SLIDE HANDWHEEL COUNTERCLOCKWISE TO MOVE THE TABLE OUT .500" BY THE MICROMETER DIAL NOTE: THIS WILL LOCATE THE CENTER OF THE CUTTER IN THE CAP SCREW 6. LOCK CROSS SLIDE
4. CUT SLOT	1. TURN COOLANT PUMP ON NOTE: IF MACHINE HAS NO COOLANT PUMP USE OIL CAN AND CUTTING OIL 2. TURN LONGITUDINAL HANDWHEEL UNTIL WORK PIECE TOUCHES THE REVOLVING SLITTING SAW 3. ENGAGE AUTOMATIC FEED 4. WHEN CUTTER HAS COMPLETED CUT, DISENGAGE AUTOMATIC FEED AND RETURN TABLE TO STARTING POINT OF CUT BY TURNING THE LONGITUDINAL HANDWHEEL 5. TURN MACHINE OFF 6. REMOVE FILLISTER HEAD CAP SCREW FROM V BLOCK 7. WIPE CLEAN
5. INSPECT	1. .138" ± .010" WIDTH OF SLOT 2. .240" ± .010" DEPTH OF SLOT
6. CLEAN UP	WHEN ALL THE PARTS HAVE BEEN CUT CLEAN MACHINE THOROUGHLY

SKETCHES: DRAWING #23: FILLISTER HEAD CAP SCREW

MACHINE SHOP   SQUARE HEAD SET SCREW

TURRET LATHE 5

HEAT TREAT 8

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND MAKE A PRESCRIBED NUMBER OF SQUARE HEAD SET SCREWS ACCORDING TO SPECIFICATIONS; USING TOOLS, MACHINES, EQUIPMENT, AND MATERIALS CALLED FOR IN THE JOB.

CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

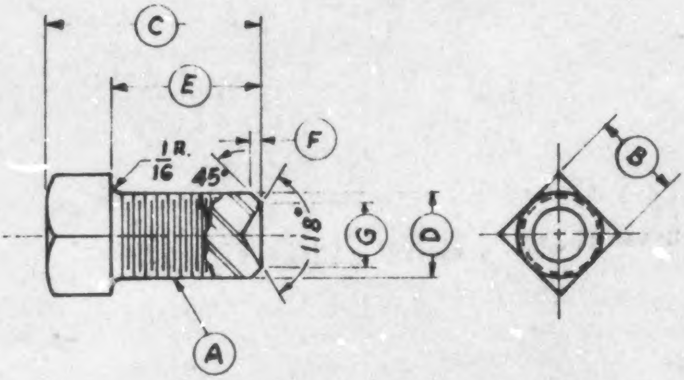
REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.

REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS.

NOTE: THE TASK SHEETS FOR THIS JOB ARE DESIGNED FOR REF. #5 ON DRAWING #24. IF OTHER SIZES ARE DESIRED, DIMENSIONS MUST BE CHANGED ACCORDINGLY.



HARDEN & DRAW

REF. NO.	"A" THD. SIZE	"B" STOCK	"C" LGTH.	"D" $^{+.000}_{-.005}$	"E"	"F"	"G" FULL DIA.
1	1/4-20 N.C.	1/4	3/4	.250	9/16	3/64	5/32
2	5/16-18 N.C.	5/16	3/4	.312	33/64	1/16	3/16
3	3/8-16 N.C.	3/8	1	375	23/32	1/16	1/4
4	7/16-14 N.C.	7/16	1	.437	43/64	5/64	9/32
5	1/2-13 N.C.	1/2	1 1/4	.500	7/8	3/32	5/16

DRAWING NO. 24	SQUARE HEAD SET SCREW	TOLERANCES UNLESS OTHERWISE NOTED
TURRET LATHE JOB NO. 5	MATERIAL: TOOL STEEL FINISH: TOOL SCALE: FULL SIZE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4°

JOB SHEET
IN
TURRET LATHE

JOB: MAKE PRESCRIBED NUMBER OF SQUARE HEAD SET SCREWS

MATERIALS: BAR OF 1/2" SQUARE TOOL STEEL

TOOLS AND EQUIPMENT: TURRET LATHE, FEED FINGERS, 1/2" SQUARE COLLET, STOCK STOP, BOX TURNING TOOL, 1/2"-20 N. C. THREADING DIE, SPECIAL 118° COUNTERSINK DRILL, CHAMFERING TOOL, COMBINATION FORMING AND CUT-OFF TOOL, MILL FILE, 1" MICROMETER, THREAD GAUGE, 6" RULE, BAR STOCK SUPPORT

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #3, PP. 201. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

TL-4-1 CHECK TURRET LATHE FOR PROPER RUNNING CONDITION, STEEL WASHERS, TL-1-1

TL-4-2 INSTALL 1/2" SQUARE COLLET IN SPINDLE OF MACHINE, STEEL WASHERS, TL-1-2

TL-4-3 INSTALL PROPER FEED FINGERS, STEEL WASHERS, TL-1-2

TL-4-4 INSTALL TURRET TOOLS AND SET CORRESPONDING STOPS, STEEL WASHERS, TL-1-2
SUGGESTED LAYOUT:
a. STOCK STOP
b. BOX TURNING TOOL
c. THREADING DIE
d. SPECIAL 118° COUNTERSINK DRILL

TL-4-5 INSTALL TOOLS IN TURRET TOOL POST AND CORRESPONDING STOPS, STEEL WASHERS, TL-1-2
SUGGESTED LAYOUT:
a. CHAMFERING TOOL
b. COMBINATION FORMING AND CUT-OFF TOOL

TL-4-6 SET FEEDS AND SPEEDS, STEEL WASHERS, TL-1-2

TL-4-7 MAKE ONE SQUARE HEAD SET SCREW, FILLISTER HEAD CAP SCREW, TL-3-7
NOTE: USE SPECIAL 118° COUNTERSINK DRILL. COUNTERSINK UNTIL 5/16" WIDTH IS OBTAINED.

TL-4-8 MAKE REQUIRED NUMBER IN PRODUCTION MANNER
NOTE: INSPECT ALL DIMENSIONS

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. MACHINE SET UP PROPERLY.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. 1/2"-20 N. C. NUT FITS PROPERLY.
4. SPECIAL 118° COUNTERSINK DRILL SET UP PROPERLY.
5. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.
6. STUDENT SHOULD SEEK SPEED IN PERFORMANCE AS IS REQUIRED IN PRODUCTION SHOPS.

SKETCHES: DRAWING #24: SQUARE HEAD SET SCREW

HT-8

JOB SHEET
IN
HEAT-TREATMENT AND DRAWING

JOB: MAKE PRESCRIBED NUMBER OF SQUARE HEAD SET SCREWS

MATERIALS: PARTS MADE ON TURRET LATHE

TOOLS AND EQUIPMENT: BLAST FURNACE, TONGS, PYROMETER OR (OPTIONAL-VISUAL COLOR), VAT OF MINERAL OIL, FACE SHIELD

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #1, PP. 31-1 TO 31-8 AND REF. #2, PP. 357 TO 370. CHECK WITH INSTRUCTOR BEFORE OPERATING FURNACE.

PROCEDURES AND/OR TASKS:

HT-8-1	CHECK FURNACE FOR PROPER OPERATING CONDITION, PARALLEL BLOCKS, HT-1-1
HT-8-2	HEAT-TREAT PARTS FROM 1700°F. TO 1800°F. PARALLEL BLOCKS, HT-1-3 AND JIG BUSHING, HT-7
HT-8-3	QUENCH IN MINERAL OIL, PARALLEL BLOCKS, HT-1-3
HT-8-4	DRAW TEMPER TO 550°F. REF. #2, PP. 362-363

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. SQUARE HEAD SET SCREWS ARE HARDENED AND TEMPERED TO PROPER HARDNESS.
2. ALL INFLAMMABLE ITEMS REMOVED FROM FURNACE AREA.
3. EXTREME CAUTION OBSERVED AT ALL TIMES.

SKETCHES: DRAWING #24: SQUARE HEAD SET SCREW

TASK SHEET

JOB: HT-8
TASK: 4
PAGE: 1

TASK: DRAW TEMPER TO 550°F.

JOB: MAKE SQUARE HEAD SET SCREWS

TRADE: MACHINIST

TOOLS AND MATERIALS: BLAST FURNACE, TONGS, PYROMETER OR (OPTIONAL-VISUAL COLOR), FACE SHIELD

TASK BREAKDOWN:

STEPS	KEY POINTS
	NOTE: DRAWING OR TEMPERING OF METAL IS A SLOW HEAT-TREATING PROCESS THAT REQUIRES A PERIOD OF SOAKING IN THE FURNACE FOR A PRESCRIBED AMOUNT OF TIME TO RELIEVE INTERNAL STRAIN AND INCREASE THE TOUGHNESS
1. LIGHT FURNACE	1. PLACE SQUARE HEAD SET SCREWS IN FURNACE 2. LIGHT FURNACE NOTE: SET FIRE TO A PIECE OF PAPER IN FURNACE, THEN TURN GAS ON
2. DRAW TEMPER PARTS	1. ALLOW FURNACE TEMPERATURE TO INCREASE SLOWLY TO 550°F. NOTE: FOR BEST RESULTS IT SHOULD REQUIRE ABOUT FIFTEEN MINUTES FOR FURNACE TO OBTAIN THE DESIRED TEMPERATURE 2. ALLOW PARTS TO SOAK AT 550°F. FOR ONE HOUR NOTE: PARTS SHOULD OBTAIN A VIOLET COLOR
3. COOL PARTS	1. TURN FURNACE GAS OFF 2. LEAVE PARTS IN FURNACE TO COOL SLOWLY AS THE FURNACE COOLS
4. INSPECT	NOTE: MOST SCHOOL SHOPS DO NOT OWN A HARDNESS OR TOUGHNESS TESTING MACHINE AND A SPARK TEST WILL

4. INSPECT (CON'T.)

BE REQUIRED. (SEE REF. #1, PP. 1-14)

SKETCHES: DRAWING #24: SQUARE HEAD SET SCREW

MACHINE SHOP HEX HEAD CAP SCREW

TURRET LATHE 6

AIM: THE STUDENT WILL BE ABLE TO SELECT MATERIALS, READ DRAWINGS, AND MAKE A PRESCRIBED NUMBER OF HEX HEAD CAP SCREWS ACCORDING TO SPECIFICATIONS; USING TOOLS, MACHINES, EQUIPMENT, AND MATERIALS CALLED FOR IN THE JOB.

CHECKING STANDARDS

1. SELECTION OF TOOLS, EQUIPMENT, AND SUPPLIES.
2. SET UP AND PREPARE MACHINE FOR JOB.
3. LAYOUT ACCORDING TO SPECIFICATIONS AND DRAWING.
4. HOLD ALL DIMENSIONS TO PRINT SPECIFICATIONS.
5. HOLD ALL SURFACES TO PRECISION FINISH.
6. HOLD SURFACE FINISH TO STANDARDS OF CRAFTSMANSHIP.
7. MAINTAIN TOOLS, MACHINES, AND EQUIPMENT IN GOOD WORKING ORDER AND REPAIR.
8. MAINTAIN AN ATTITUDE OF APPRECIATION FOR WORK, MATERIALS, TOOLS, EQUIPMENT, MACHINES, AND SPECIFICATIONS.
9. MAINTAIN SAFE WORKING HABITS.

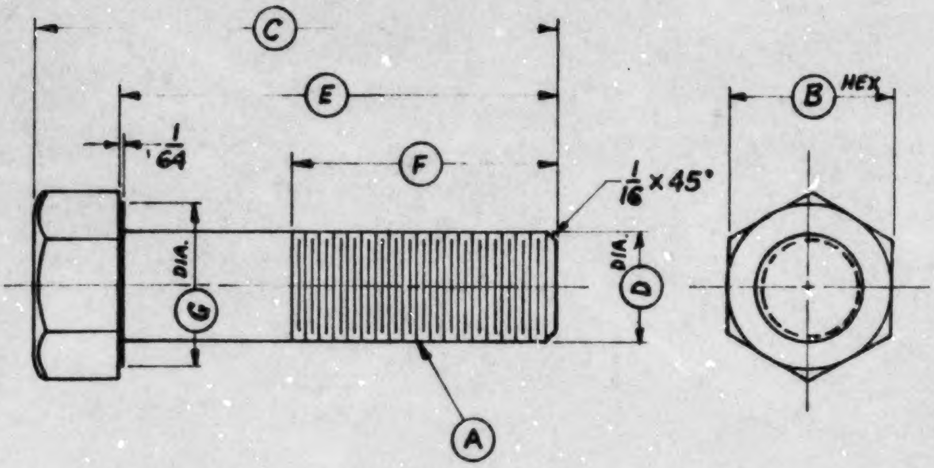
REFERENCES

REF. #1, WALKER, JOHN R., MODERN METALWORKING.

REF. #2, LUDWIG, OSWALD A. AND WILLARD J. MCCARTHY, METALWORK TECHNOLOGY AND PRACTICE.

REF. #3, WALKER, JOHN R., MACHINING FUNDAMENTALS.

NOTE: THE TASK SHEETS FOR THIS JOB ARE DESIGNED FOR REF. #5 OF DRAWING #25. IF OTHER SIZES ARE DESIRED, DIMENSIONS MUST BE CHANGED ACCORDINGLY.



REF. NO.	"A" THREAD	STOCK SIZE "B"	STOCK SIZE "C"	"D" +.000 -.005	"E"	"F"	"G"
1A	1/4-20 N.C.	7/16	1 3/16	.250	1	7/8	7/16
1B	1/4-28 N.F.						
2A	5/16-18 N.C.	9/16	1 31/64	.312	1 1/4	1	9/16
2B	5/16-24 N.F.						
3A	3/8-16 N.C.	5/8	1 25/32	.375	1 1/2	1 1/8	5/8
3B	3/8-24 N.F.						
4A	1/2-13 N.C.	13/16	2 3/8	.500	2	1 1/4	13/16
4B	1/2-20 N.F.						
6A	5/8-11 N.C.	15/16	2 31/32	.625	2 1/2	1 1/2	15/16
5B	5/8-18 N.F.						

DRAWING NO. 25	HEX HEAD CAP SCREW	TOLERANCES UNLESS OTHERWISE NOTED
TURRET LATHE JOB NO. 6	MATERIAL: C.R. STEEL FINISH: TOOL SCALE: FULL SIZE	FRACTIONS - ± 1/64" DECIMAL - ± .005" ANGLES - ± 1/4°

JOB SHEET
IN
TURRET LATHE

TL-5

JOB: MAKE PRESCRIBED NUMBER OF HEX HEAD CAP SCREWS

MATERIALS: BAR OF 15/16" HEXAGON COLD ROLLED STEEL

TOOLS AND EQUIPMENT: TURRET LATHE, FEED FINGERS, 15/16" HEXAGON COLLET OR THREE-JAW UNIVERSAL AUTOMATIC CHUCK, STOCK STOP, BOX TURNING TOOL, 5/8"-11 N. C. THREADING DIE, CHAMFERING TOOL, COMBINATION FORMING AND CUT-OFF TOOL, 1" MICROMETER, THREAD GAUGE, FLAT FILE, 6" OR 12" RULE, BAR STOCK SUPPORT

GENERAL INSTRUCTIONS: BEFORE BEGINNING THIS JOB REVIEW REF. #3, P. 201. CHECK WITH INSTRUCTOR BEFORE OPERATING MACHINE.

PROCEDURES AND/OR TASKS:

TL-5-1	CHECK TURRET LATHE FOR PROPER RUNNING CONDITION, STEEL WASHERS, TL-1-1
TL-5-2	INSTALL 15/16" HEXAGON COLLET IN SPINDLE OF MACHINE, STEEL WASHERS, TL-1-2
TL-5-3	INSTALL PROPER FEED FINGERS, STEEL WASHERS, TL-1-2
TL-5-4	INSTALL TURRET TOOLS AND SET CORRESPONDING STOPS, STEEL WASHERS, TL-1-2 AND FILLISTER HEAD CAP SCREWS, TL-3-2 SUGGESTED LAYOUT: a. CHAMFERING TOOL b. BOX TURNING TOOL c. THREADING DIE
TL-5-5	INSTALL TOOLS IN TURRET TOOL POST AND CORRESPONDING STOPS, STEEL WASHERS, TL-1-2 AND FILLISTER HEAD CAP SCREWS, TL-2 SUGGESTED LAYOUT: a. CHAMFERING TOOL b. COMBINATION FORMING AND CUT-OFF TOOL
TL-5-6	SET FEEDS AND SPEEDS, STEEL WASHERS, TL-1-2
TL-5-7	MAKE ONE HEXAGON HEAD CAP SCREW, FILLISTER HEAD CAP SCREWS, TL-3-7
TL-5-8	MAKE REQUIRED NUMBER IN PRODUCTION MANNER, (TASK7)

CHECK POINTS: STUDENT TO CONFER WITH INSTRUCTOR AT THESE INDICATED POINTS BEFORE PROCEEDING WITH TASK.

1. MACHINE SET UP PROPERLY.
2. ALL DIMENSIONS HELD TO SPECIFICATIONS.
3. 5/8"-11 N. C. NUT FITS THREADS PROPERLY.
4. CRAFTSMANLIKE PERFORMANCE AND APPRECIATION FOR TOOLS, EQUIPMENT, AND STANDARDS.
5. STUDENT SHOULD DEMONSTRATE SKILL, SPEED, AND ABILITY AS REQUIRED BY THE STANDARDS OF INDUSTRY, AND DEMONSTRATE AN ACCEPTABLE KNOWLEDGE OF THE TRADE AS INFORMATION RETAINED FROM THE PREVIOUS TWENTY-FOUR JOBS.

SKETCHES: DRAWING #25: HEX HEAD CAP SCREW